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Contractors and Engineers Monthly

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Highlights Of This Issue

- **Preventing Frost Boils**

  The cause and cure of this bane of the highway maintenance engineer's existence are discussed in considerable detail, with explanations and descriptions of the prevention of heaving and frost boils on highways. See page 2.

- **Wellpoints on Bridge Job**

  A feature of the construction of a 456-foot concrete bridge over the Rocky River in South Carolina was the contractor's use of wellpoints to keep water from the bridge pier caisson. See page 2.

- **Trouble in Alaska**

  Just a few of the major and minor difficulties in organizing a road construction job in Alaska, without much equipment and miles from a base of supplies, are amusingly described in this issue. See page 11.

- **Stabilizing Sand Road**

  Asphalt and coquina rock were used effectively to stabilize a section of new highway through sand on Anastasia Island in Florida. See page 13.

- **Highway Maintenance Depot**

  Another in our series of articles on well-planned and equipped highway maintenance depots describes the recently constructed maintenance stations in Wyoming, designed to meet the varying conditions of climate and terrain in that state. See page 21.

- **Arbitration in Construction**

  Why and how provision for arbitration should be incorporated in construction contracts is discussed in an article which also includes a brief history of arbitration in this country and the advantages of applying arbitration methods to disputes. See page 27.

- **Wisconsin Grading Job**

  The contractor for a tough grading job in Wisconsin executed the work with speed and efficiency, using two power shovels loading to separate hauling fleets, and two scraper outfits. See page 32.

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Huge Earth-Fill Dam

Well Organized Dirt Moving With Large, New Equipment Makes Progress at Hansen Dam in California

An Auto Patrol Leveling Material Spread by the Earth-Moving Equipment at Hansen Dam, Calif. Spillway Construction Is Seen in the Background

(Photos on page 40)

✦ THE control of cloudbursts in the canyons of the San Gabriel Mountains lying to the east of Los Angeles has engaged the attention of Los Angeles County for many years and more recently of the U.S. Engineer Department. The program has developed into the construction of more and larger flood-control basins which will store all the flood waters and not be filled with the aggregation of boulders, cobbles and disintegrated granite brought down by a single storm.

Hansen Dam is the largest of these flood-control structures and is located on Tujunga Wash, a tributary of the Los Angeles River, near San Fernando, Calif. The drainage area directly contributary to the basin created by the huge earth dam now under construction is 147.4 square miles and the maximum total inflow expected from any one 4-day storm is 45,200 acre-feet. This will be absorbed in the 27,600 acre-feet of reservoir capacity back of the dam while a controlled flow of 12,000 cfs will be released through the eight 5 x 8-foot gated openings in the dam and the two 8 x 6-foot ungated openings. A spillway crest 284 feet in length at the middle of the dam can also discharge 101,000 cfs at a 22-foot surcharge on the spillway crest.

The dam which is now under construction by Guy F. Atkinson Company will contain 12,900,000 cubic yards of earth at its completion, with a crest of 122 feet above stream bed. Its total length is 9,050 feet and the average width is 1,050 feet at the base. The body of the dam is divided into five zones, starting with Zone 1 at the upstream face. This face consists of 12-inch rock paving with a 6-inch gravel backing on a slope of 3 to 1 with a 20-foot berm at Elevation 1,040. Crest elevation is 1,087. The material in Zone 1 will consist of selected material impervious in character. Similar selected material rolled to maximum density comprises Zone 2 which is 15 feet wide at the top elevation of the dam and slopes ½ to 1 to the ground surface where it is continued into the ground to a depth averaging 20 feet, narrowing on 1 to 1 slopes to a 20-foot minimum width. The concrete spillway structure is located where the dam crosses Hansen Knob, the only rock on

(Continued on page 10)

County-State Job Improves Old Road

State Highway Dept. and Baldwin County Rebuild Secondary Road South of Foley, Alabama

(Photos on page 40)

✦ DURING the summer of 1938 the Alabama State Highway Department and Baldwin County, in the southern part of the state where potato growing is the major industry, completed the regrading and surfacing of 11 miles of old sand-clay road south of Foley, including the construction of numerous drainage structures. The cost of the project, about $103,100, was divided equally between the state and the county, with state supervision and county equipment being charged to the respective contributions.

Work was started with combined state and county effort on September 15, 1937, and continued throughout the winter with final completion on August 15, 1938. The road connects Foley with the road to Fort Morgan opposite the prospective new all-year resort on Dauphin Island south of Mobile. At the southern end of this state and county project was 6,900 feet of relocation which required the moving of one of the most interesting and unusual bridge structures in the world. The old road crossed the Intra-Coastal Canal on a floating double bascule bridge, the floating portion of which is a concrete barge, a relic of World War prodigality. Two short bascule spans from the fixed shore ends release the barge when raised, permitting it to be pulled diagonally away from mid-stream, thus clearing the channel.

(Continued on page 18)

WORKING A HEAVY GRADING JOB

Two of Ryan Bros.' Allis-Chalmers Speed Ace Hauling Units Being Loaded by a Manitowoc Speedshovel. See Page 32.

Causes of Frost Heaving And Ways to Prevent It

Studies Prove Theories Correct; the Treatment of Bad Cases Described to Eliminate "Boils"

By J. O. OSTERBERG, Research Fellow, Cornell University

(Photo on page 40)

✦ GO SLOW, frost heaves—Slow, bad bump ahead—Caution, road badly heaved 2 miles—how often we see these signs in the northern states right after the first spring thaw and on into early summer! We see roads torn apart, culverts cracked and heaved, stones pushed out of the ground, and foundations lifted and broken. All this has been observed for many centuries, but it is not until recently that the cause has been fully understood. Today, though the physical and theoretical approach to the frost action problem is quite complicated, the practical aspects are quite simple. In many cases frost boils can be eliminated by a few simple measures. In fact, even in cases where elimination of heaving may be costly, it is often cheaper than the annual expense of repairs. Unfortunately the principles of these protective measures are not as widely known as they should be. This article is an attempt to present as simply as possible the underlying causes of frost heaving and what may be done to prevent damage from it.

The Cause of Heaving

Previously it was thought that heaving was caused by the expansion of the water in the soil when it changes into ice, but obviously when we look at the facts, this cannot account for the large amount of heaving observed. When water freezes, its volume increases about 9 per cent. If a soil contains 25 per cent water, let us say, and the frost has penetrated 2 feet into the ground, the total heave would be only about ½ inch. But actually heaves are as large as a foot or even several feet, more than the frost depth itself in extreme cases. What then causes this excessive heaving? If one examines a sample of frozen soil that has heaved, it is noticed that the soil contains many lenses or strata of clear ice rather uniform and evenly spaced. The total thickness of all these ice lenses corresponds very nearly to the total frost heave observed. Thus, it is the accumulation of the ice layers themselves apart from the soil that causes heaving. In soils which heave excessively, these ice layers may be quite thick and numerous, and the water content of the frozen soil may be 100 per cent of the dry weight of soil, or even much more. This large amount of water is often more than the soil can hold in an unfrozen state. Therefore, the water could not have been there to begin with, but must have flowed to the freezing zone from below. This is the cause of heaving.

Though this may seem obvious, it was not until quite recently that this fundamental fact was noticed. Simon Johansson (1914) was the first to demonstrate that in order to have an appreciable heave, there must be a supply of water to the freezing zone from the the ground water table, and also that the freezing of the water pre-existing in the frost zone caused practically no heave. Later, Taber showed the same thing. By substituting for water other liquids which decrease in volume on solidifying, he still obtained heaving, providing the freezing soil column was able to suck up liquid from below by capillary flow.

The rapid development of highway construction made necessary by the automobile was primarily responsible for giving serious attention to the problem of frost action, though long before this it had an important effect on transportation. The old stage-coach roads were in such bad condition in the spring that many were impassable. It was thought that this condition was due entirely to the spring rains and the thawing of surface snow and ice, but it was not realized that much of the condition was due to the melting ice layers in the soil, and to the fact that the still frozen layers underneath prevented drainage of the surface water.

The first collective action on this problem was taken in Sweden in 1925, where a conference of highway and railroad engineers was held. This conference led to the joint undertaking by the Swedish Institute of Roads and the Swedish Geological Survey of a comprehensive theoretical and practical investigation of the entire problem. Dr. Gunnar Beskow published a lengthy treatise on the results of this investigation in 1935, and it is to date the most complete and authoritative publication on the subject. In this country considerable work has been done by Stephen Taber, A. Casagrande, and others.

Bad Frost Boils on a Macadam Road at Dryden, N. Y., After a Severe Winter

A Typical Frost Boil on a Macadam Road in New York State. The Boil Is Entirely Soft and a Stick Can Be Pushed Far Down into the Plastic Mass

Mechanics of Frost Heaving

Different types of soil freeze in different ways, depending upon grain size. Sands and the coarser silts freeze homogeneously, forming no ice banding and therefore cause no frost heave under ordinary conditions. The finer soils, however, form ice lenses or strata on freezing which appear in a rhythmic pattern of banding through the frozen zone, usually parallel to the ground surface. The finer the soil, the thicker and further spaced the lenses become.

A very significant fact about a stratified frozen clay is that the soil between the ice beds is usually soft, plastic and unfrozen. Only under extreme cold does the entire soil mass freeze. The finer the soil, the more difficult it is to freeze the entire mass. A test at the U.S. Bureau of Public Roads showed that a saturated stiff clay first began to freeze just below the freezing point but a great deal of water remained unfrozen, and it was not until a temperature of —78 degrees C. was reached that the last bit froze. The cause of this is the effect of the "adsorbed" water around the soil particles. Soil particles exert a molecular attraction on the water molecules, the attracting force being large close to the particles and diminishing rapidly at a distance from the particles. Thus a few layers of water molecules close to the particle surfaces are strongly bound and form "solidified water." This is known as hygroscopic water—water which cannot be completely driven off even at very high temperatures. As this water is under pressure due to the force of adsorption, the freezing point is lowered. Therefore the water in the center of the pores, furthest away from the particles, freezes first, since it has the highest freezing point, being under less pressure. As freezing progresses, the remaining water shows more and more resistance to freezing, that is, it freezes at a lower temperature since it is under greater pressure. Also, the finer the soil, and consequently the smaller the voids, the closer the water molecules in the center of the pores come to the particles. The force of adsorption then increases, and the initial freezing point is lowered, and the amount of water remaining unfrozen at any given temperature is greater.

This phenomena is a key to the explanation of the manner in which ice segregation occurs in a freezing soil. The first ice crystals appear in the center of the void space where the freezing point is highest. A crystal thus started

(Continued on page 14)

New Concrete Bridge Spans Rocky River

Boyle Road & Bridge Co. Used Wellpoint System For Pier Foundations On South Carolina Job

✦ WITH what is reported to be the first wellpoint system that has been used to keep water from a bridge pier caisson in the state of South Carolina, the Boyle Road & Bridge Co. of Sumter, S. C., started January 5, 1938, on the construction of the 456-foot Rocky River Bridge between Abbeville and Loundesville, S. C. The concrete bridge consists of two open end bents and seven two-column piers with caps carrying the four concrete arched girders supporting the deck. The spans from east to west are one 114-foot continuous span poured as two 57-foot spans with a construction joint between, and then two 171-foot continuous spans. The piers are uniformly spaced 57 feet center to center, and the spans were poured with a construction joint over each intermediate pier. The structure spans the bed of the stream although the usual flow will be beneath the second and third 57-foot span from the west end. The need for the use of the wellpoint system was explained by the presence of the old stream bed and the consequent deposit of gravel at the location of No. 5 pier.

Abutments

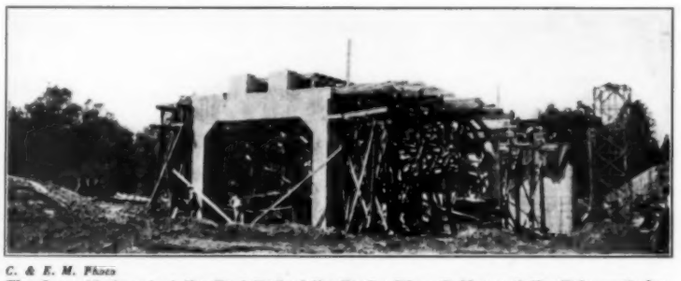
The west abutment on rock consists of a concrete footing 4 x 18 feet in plan and 4 feet 6 inches high. The footing carries a column 5 feet 6 inches wide and 2 feet thick at the bottom with the rear face against the earth fill vertical and the front face battered 1 on 6 and heavily reinforced. The bent is 39 feet high. The east abutment is identical except that it has columns 30 feet in height while the west abutment columns are 39 feet high.

Pier No. 5

Pier No. 5, the third from the east end, was the problem child as regards the handling of the footing. It has two footings 10 feet in diameter on rock and 20 feet 3 inches center to center. Two separate caissons 12 feet in diameter were driven, using 3 x 8-inch sheeting. As these footings were in the bed of the old stream there was considerable trouble with an excess of water coming around the bottom of the sheeting so a wellpoint system with the points on 6-foot centers was installed to remove the water from around the caisson and completely dry up the excavation. The points were jetted down 20 feet and about 4 feet outside the sheeting. A Novo road pump was used for the jetting water and a Jaeger wellpoint pump was used to remove the water from the system when the connections were completed. This wellpoint system was used only on the two footings at Pier 5. The others were reasonably tight and such water as entered was removed from a sump with Jaeger Sure Prime pumps.

The sheeting on each of the piers was driven around heavy wooden segmental rings used as spacers and wales spaced 4 feet on centers vertically. The drop

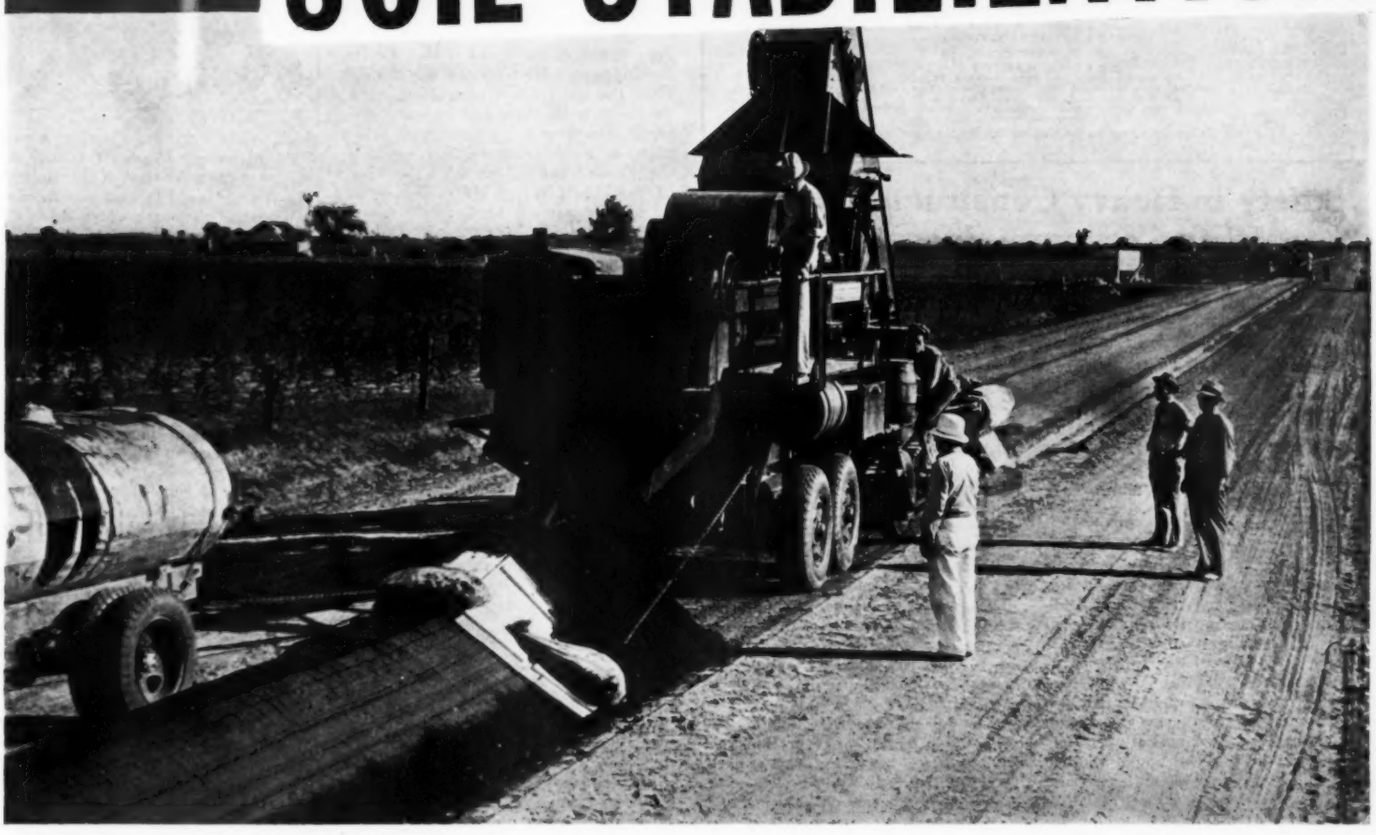
(Concluded on page 28)



C. & E. M. Photo

The Open Abutment at the East End of the Rocky River Bridge and the Falsework for the First Arch

In the road-building industry today it's SOIL STABILIZATION



A large Soil Stabilization project in Fort Bend County, Texas, which called for 1,500,000 gallons of TEXACO RC Surfacing Material No. 3, a rapid-curing Cutback Asphalt.

Soil Stabilization is one of the most important recent forward steps in road and street construction. Page after page in engineering journals and speaker after speaker at engineering meetings discuss the significant effect of this development on road building economy and efficiency.

As in many other phases of highway and street construction and maintenance, TEXACO Asphaltic products accurately meet Soil Stabilization needs in all parts of the country.

One of the outstanding 1939 Soil Stabilization projects to date has been undertaken by Fort Bend County, Texas. TEXACO RC Surfacing Material No. 3, a rapid-curing Cutback Asphalt, is being used. This project will require approximately 1,500,000 gallons.

For practical, helpful assistance in selecting the correct TEXACO Asphaltic product for your Soil Stabilization project, call on our laboratory and field organization for cooperation. Write us today.

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Safety in Heavy Construction Starts With Company Executives

By R. J. REIGELUTH,

Vice President, C. W. Blakeslee & Sons, Inc.; Vice Chairman for Heavy Construction, Construction Section, National Safety Council

A study of any safety record must be concerned first with the cause and secondly with the remedy for the situation. Such a study will reveal that many accidents in all lines of work are the result of disordered thinking. This is often indicated in workers by evidence of absentmindedness, worries, and lack of mental application to the definite requirements of the task at hand. But this same disordered thinking extends also into the executive branch of the business, taking form in the mental attitude of the management toward the problem of safety among its employees. It is to this condition in the executive branch of the construction industry that we address this editorial. Management is concerned with practical matters: smooth-running machinery (personal and mechanical), economical operation, low prices, and profits. Sound-thinking management knows that as a practical matter, from every practical point of view, it pays to be safe.

Whenever management focuses its mental processes on safety, orderly and systematic achievement, economically arrived at, invariably results. As a suggestion to management, three of the most natural and effective lines of procedure along which it may direct its thought and conduct its attack on this problem are: first, the selection of men for the various jobs; second, the control of the equipment of the men; and third, the control of the training of the men for the particular job at hand.

The *selection* of the men is entirely a function of management which, if not performed with caution and judgment, creates a condition so unsafe that no amount of effort and cooperation on the part of the workers can offset it. In case of hasty or careless selection of an unsafe man for a job, not only is his own personal safety endangered, but the safety of all his co-workers is in jeopardy. Superintendents employing men should consider their qualifications as to age, weight, strength, eyesight, quickness, and responsiveness. Some operations demand excellence in all these qualities; other occupations do not necessarily require for safety that a man have youth and strength; and in some jobs a man may be slow in his reactions and still be safe. Certainly a rigger must be young and quick, a mason must be strong and have good eyes, while a stock clerk may be old and slow in his reactions.

The *equipment* of a worker may be his own personal problem in a large measure, but it can and should be, in the interests of safety, controlled and supervised by the management. The term "equipment" covers all the accoutrements a workman may need, such as clothing, hand tools, proper footing or standing space, machinery, and mechanical tools.

Where management has made an orderly study of the safety problems and the hazards of its operation, the executive staff can readily prescribe the clothing needed for safety on its work. Here again riggers, masons and stock clerks have differing needs. Each case should be studied and proper requirements administered.

Proper hand tools in good condition are essential to economical workmanship as well as to safe workmanship. Accidents and costs have been increased by men using a pipe for a crowbar or a monkey wrench for a hammer. Good management will correct such things.

Safe footing makes for better efficiency in any operation, and is part of equipment. Pump men on cofferdams require a platform with a railing. A scaffold must furnish sufficient room for tools and still provide ample walking and foot space. The men are entitled to have management provide them a fair chance to work safely.

Mechanical failures have no place on a construction job and they are, as a matter of record, not large. Obviously, however, a mechanical failure may be disastrous; that careful and frequent inspection provides cheap insurance against both liability and loss is the inevitable conclusion of any extended thought.

The *training* of men in safety is considered by many executives fully as important as training in production. After the men have been carefully selected and adequately equipped, management still has a grave responsibility in seeing to it that the men are properly trained and directed in the safe and economical methods that should be adopted for each particular operation. No management, delinquent in this function, can be said to have properly discharged its obligation, either to its owner or to its workers.

We appeal to all construction executives that in their study of the causes of accidents and the remedies, they direct their thinking to the selection, equipment, and training of workmen for safe and economical operations.

Zoning as an Aid to Roadside Development

To the Editor

CONTRACTORS AND ENGINEERS MONTHLY

I am glad of the opportunity to congratulate you most heartily on your plan of awards which recognizes the important part played by the highway contractor in preserving and increasing the attractiveness of the 800,000 miles of roadsides in our country.

As a nation of highway travelers we enjoy a lovely road without much thought of the care and effort that has gone into it or the responsibility for its development. We deplore the change from the quiet country roads through the woods to the three and four-lane motor highways and are ready with criticism of roadside scars and needless sacrifices of fine old trees. A good job of roadside planting should never be taken for granted, whether on a new route or a widening or relocation of an old road. To overcome the handicap of physical conditions and the meagerness of funds for roadside development requires a high order of skill. May I point out, in this connection, the success of those highway departments

which consider the road borders a part of the highway and plan for their development from the start of the project?

Do we not need to assure more permanence for the work of roadside development by protecting the highway borders from blighting uses? Highway departments and road contractors must often be discouraged to see a fine bit of planting or a naturally attractive stretch of road spoiled by a line of shabby stands and billboards. There is a place for business along the highway but business is not satisfied with locations in existing business areas. The proprietors of these wayside stands sense the desire of the traveler to rest and eat in the most attractive spots.

The right to zone along the highway in the country is as well established by the courts as the right to zone a city street, but rural communities are slowest to adopt zoning ordinances. The country land owners, and particularly the farmers, are not so easily convinced of the protective nature of zoning regulations. They can usually be stirred to vigorous opposition by the threatened invasion of their rights. Much of the trouble comes from an imperfect understanding of zoning and we contribute to this by making our county zoning ordinances too detailed and too technical. We need simpler regulations which can be read and understood by the layman and which are not so open to misinterpretation.

Yours very truly,
Flavel Shurtleff, Counsel,
American Planning and Civic Assn.
New York City,
May 23, 1939.

If contractors and state highway engineers have any questions or want further information on our Annual Roadside Development Awards, write us and we shall be glad to send full details.

PRIZE-WINNING STEEL BRIDGES

The Four Bridges Which Received the A.I.S.C. Awards for the Most Beautiful Steel Bridges Completed in 1938 in Their Respective Classes. Lower Left, the Middletown-Portland Bridge at Middletown, Conn., Winner in Class A; Middle, Capital Bridge at Frankfort, Ky., Awarded First Place in Class B; Lower Right, Span Over the Middle Fork of the Flathead River at Belton, Montana, Which Took the Class C Award; and Right, Lafayette Avenue Bridge at Bay City, Mich., Winner in the Movable Bridge Class. **See Page 38.**

Structural Welding Book Issued by Foundation

A new book, "Arc Welding in Design, Manufacture and Construction," has been published recently by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, and contains 109 original studies of welding selected from the Award papers which were submitted for the Lincoln Foundation Award last year. The book is divided into ten sections: Automotive, Aircraft, Railroad, Watercraft, Structural, Furniture and Fixtures, Commercial Welding and Automotive Repair, Containers, Machinery, and Jigs and Fixtures. It contains 1,408 pages and 695 numbered illustrations, including photographs and line drawings.

Copies may be secured at $1.50 postpaid in the United States from The James F. Lincoln Arc Welding Foundation, P.O. Box 5728, Cleveland, Ohio, by mentioning this item.

Highway Bridge Records

A survey of typical highway bridges in the United States which are built of pressure-treated timber has recently been compiled into a booklet by The Wood Preserving Corp., a Koppers Co. subsidiary, Pittsburgh, Penna. Engineering data, photographs, records of service life and maintenance, as well as savings in construction, are included. Actual costs of the pressure-creosoted bridges are given and, where available, the engineers' estimates of the costs of comparable bridges of other permanent materials. Bridges selected for the survey embrace various types built under a variety of conditions. Copies of this booklet, Form G-1, may be obtained by those interested direct from the Wood Preserving Corp. by mentioning this item.

New Distributor Catalog

Littleford Bros., 485 E. Pearl St., Cincinnati, Ohio, has recently issued a catalog entitled "Here's the Story in a Nut Shell" which contains complete information on the Littleford Model C pressure distributor and photographs showing the distributor in action. According to the manufacturer, this unit is designed to apply tar, asphalt, cut-back or emulsions with simplicity of operation and efficiency.

Copies of this catalog may be obtained by those interested direct from the manufacturer or from this magazine.

THERE'S A "CATERPILLAR" DIESEL TO SWING EVERY JOB!

This big bladeful of oil-mix gives some idea of the power and work-capacity of the "Caterpillar" Diesel No. 12 Motor Grader. Operating on about 2 gallons of low-cost fuel an hour, this machine will perform a variety of road-building and road-maintenance tasks. See the main text.

"Caterpillar" Diesel D4 Tractor with Trackson high shovel. It is shown here stripping dirt and loading gravel . . . working 8 hours a day on only 1½ gallons of 9-cent fuel an hour. Versatile, handy and economical to operate, this outfit will be one of the best investments you ever made. The tractor, itself, still has its normal drawbar-power for hauling-work. And, for pushing-work, a bulldozer can be readily attached. Owned by Plainfield Township, Illinois.

THERE'S plenty of variety to choose from among "Caterpillar" Diesel equipment—machines that couldn't fit your job any better if you got them made to order!

Consider, first of all, the "Caterpillar" Diesel No. 12 Motor Grader. Big and husky, with a 66-horsepower "Caterpillar" Diesel Engine, it can handle *heavier* work than any other motor grader!

Not only that, the No. 12 does *many kinds of work*. Its blade-positions are almost unlimited. High bank-cuts and heavy ditch-cuts are easily accomplished. And you can set the blade entirely within the wheels, or turn it *completely* around and work in reverse on sub-grades and jobs where the machine, itself, can't be readily turned.

Grading, scarifying . . . making and maintaining shoulders along dirt and concrete . . . working gravel and oil-mix are a few of the jobs done with economy and speed by a No. 12 Motor Grader!

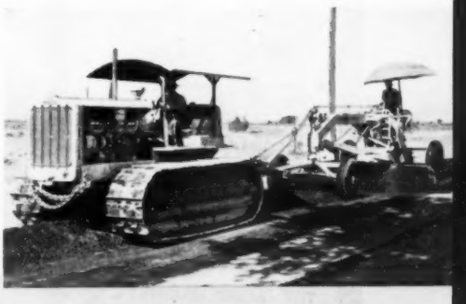
It may be, however, that your work needs a tractor. "Caterpillar" Diesels offer you a big choice *there!* You can get a D4 with a Trackson high shovel—and have *all* a tractor's advantages, as well as an efficient, economical loading-unit.

Then, there are heavier tractors—such as the D7 illustrated here. It can pull power-controlled or hand-controlled "Caterpillar" Blade Graders. Bulldozer-equipped, it can rough-out new roads . . . make cuts and fills . . . handle heavy rock . . . clear snow in Winter. And, of course, this is a *hauling* machine—ready to team-up with wagons, scrapers, tampers, rollers, *anything* that has to be moved!

No matter which "Caterpillar" Diesel outfit you pick, no matter what work you put it on, you can look for it to *pay its own way* on fuel-savings alone!

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

Tulare County, District No. 5, Terrabella, California, owns this outfit. It's a "Caterpillar" Diesel D7 Tractor and a No. 66 "Caterpillar" Grader. Grading oil-mix on a county road, near Tipton, it works 8 hours a day on only 2¼ gallons of 5¼c fuel an hour. Pulling wagons, scrapers, tampers and rollers, . . . making cuts and fills . . . are a few of the jobs done by the "Caterpillar" Diesel Tractor at exceptionally low cost!



CATERPILLAR DIESEL POWER

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DIESEL ENGINES • TRACK-TYPE TRACTORS • ROAD MACHINERY

Peons Watch with Wonder the Activities of a P & H 2½-Yard Dragline on a Mexico City Canal Project

P & H Finishes Job Begun Centuries Ago

The rural population near Mexico City turned out en masse to register sleepy-eyed wonder recently when a gringo monster in the form of a huge P & H Model 955 LC 2½-yard dragline invaded the region to finish a project started by the Spaniards centuries ago.

When Mexico City was built, the Spaniards realized that it was necessary to drain the valley or plateau, at an elevation of 7,300 feet, where the city is located. Consequently a canal was constructed through the mountains by hand labor. This canal proved to be insufficient and in later years a larger drainage canal was built from Mexico City to Sumtango, a distance of about 34 miles. From Sumtango to Tequisquiac a tunnel 16.4 feet in diameter and about 4.5 miles long was constructed by hand labor. It is brick lined and well built. The canal and tunnel were intended to take care of the sewers of Mexico City and of surplus water from the Mexican valley during the rainy season. It was found, however, that while the canal was large enough, the tunnel was too small to protect Mexico City from floods.

Therefore a new tunnel, parallel to the old one and of the same size, is now under construction. The P & H dragline is digging a canal at the outlet of this tunnel, after which it will be used to dig a canal connecting the new tunnel with the old sewage canal. This entire project, which is of great importance to Mexico City, is a very ambitious one. Several floating dredges are in use in the Lago de Texcoco, digging a canal to drain the entire valley and turn it into tillable land. Before it can be planted, however, the land must be leached of alkali, which is being done by water from the Mexico City sewer and from rivers and artesian wells. In addition, to prevent earth erosion and dust storms, millions of trees are being planted.

With so much emphasis being laid upon the development of heretofore useless land in our own country, it is interesting to note that foreign countries are also making great strides in similar projects of soil control, stabilization and development.

The importance of proper lubrication can not be stressed too often or too emphatically. If you have any special lubrication or maintenance problems, write the Editor.

A 4 to 5-Ton Roller

The Galion Iron Works & Mfg. Co., Galion, Ohio, has available, for all interested contractors and engineers, literature describing and illustrating its Galion International roller. Powered by the International I-30 power unit, this roller is particularly adaptable for such use as compacting patches and repair work, shoulder maintenance, resurfacing, light construction and rebuilding jobs. Although its basic weight is but 4 tons, it can be increased up to 5 tons by the addition of water ballast in the three rolls.

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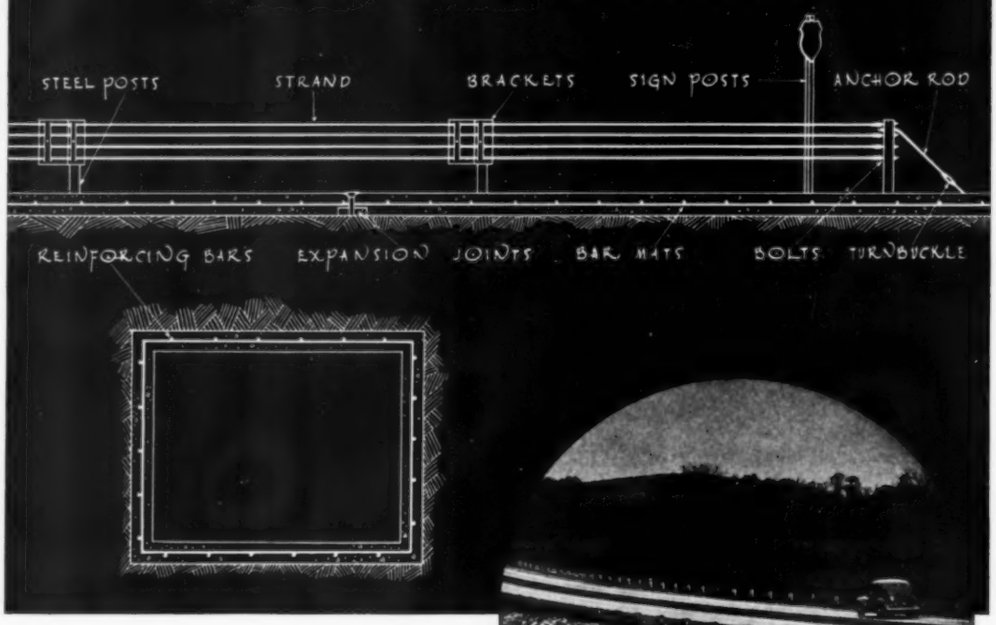

Bethlehem furnishes virtually every form of steel for road construction from reinforcing bars to the smallest fastening in a cable guard assembly. Large stocks of each item are held in constant readiness for shipment from warehouses serving major construction areas.

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Highway Studies Of Traffic Needs

Three-Lane Highway Is Not As Hazardous As Painted; Areas Near Cities Are Most Dangerous in Michigan

By D. GRANT MICKLE,
Assistant Director, Michigan Highway Planning Survey, and Manager, Traffic and Transport Department, Jensen, Bowen & Farrell, Engineers

✦ THE fundamental requirements in the design of both urban and rural roadways are that their lateral dimensions be sufficient for the volumes of traffic to be served and that their longitudinal design be suitable for orderly movement at such speeds as the service demands. Simple as these requirements appear to be, there is a wide variety in the relative emphasis given to them under varying conditions. In ordinary urban areas, for example, high concentrations of vehicles make capacity the principal criterion of roadway efficiency while, on the other hand, the long distances between the origins and destinations of rural trunkline travel give a predominant importance to the factors governing speed.

Safety design is particularly concerned with the selection of means to attain the necessary adjustment between these two requirements. It is not a separate specification added to the requirements for capacity and speed, but is part and parcel with them.

Rural Highways

The function of rural trunkline highways is to carry traffic between relatively widely separated points as rapidly as the nature of the service demands. As the traffic stream increases in volume and as its composition becomes more varied, the need for special measures to protect it from internal conflicts is greater. The methods of attacking the problem of providing this protection are of many different kinds. During the past two years the Michigan State Highway Department, cooperating with the U. S. Bureau of Public Roads in a state-wide highway planning survey, has been investigating the limited but important subjects of pavement usage and lane widths.

Since speed is the major requirement of travel on trunkline highways, it is essential to know what effect various rates of speed have on the usage of the pavements by different classes of vehicles. Since the traffic stream contains various types of vehicles traveling at different rates of speed, it is essential to know what clearance distances are involved in actual overtaking and passing maneuvers and, since larger vehicles are ordinarily the slower ones and so are involved more frequently in overtaking and passing maneuvers, it is desirable to know what effect these have on pavement use and traffic safety. These three problems were the subject of special investigation in Michigan and the facts which were revealed resulted in changes in the standards of highway design in that state.

Wider Lanes and Segregated Traffic

Observations which were the basis for the study of vehicle placement were made on two sections of U. S. 10 between Pontiac and Flint, one section being a straight and almost level stretch and the other a section on a 7-degree curve. A study of the traffic on these sections furnished considerable valuable data on the placement of vehicles during overtaking and passing maneuvers and on the inside and outside of the curve.

On the basis of these placement studies and of further observations in the field, computations were made of the dimensional aspects of pavement usage in overtaking and passing maneuvers. Five lateral dimensions make up the overall pavement space required. These are: 1. edge of pavement clearance; 2. width of vehicle overtaken; 3. passing clearance; 4. width of overtaking vehicle; 5. centerline clearance. The result of these observations reinforced by accident experience on all types of pavements with 10-foot lanes led to the increase of Michigan's standard for lane width to 11 feet. Serious consideration is being given to increasing also the width of the outside lane on curves. These studies also pointed to the need for further study of the problem of segregating widely differing types of traffic.

Multiple-Lane and Divided Roads

Since it is not likely that the near future will see any very considerable mileage of exclusive high-speed and commercial highways, the problem of providing facilities which will permit the safe operation of the present highly heterogeneous traffic on the same highway continues to be of great importance.

While an increasingly large majority of highway authorities are turning to divided roadways as the ultimate form for heavy traffic trunklines, the relative value and safety of undivided multi-lane pavements still demands much investigation. This is particularly true of the three-lane pavement which has quite generally a very bad reputation.

A preliminary examination and analysis of accident records on Michigan two, three, and four-lane undivided trunklines covering the past four years does not bear out the charge that the three-lane highway is especially hazardous. Actually, the figures appear to indicate that, when careful alignment gives proper sight distance, it is the safest of the three. On the basis of these studies, it seems that this much debated type of highway serves a very useful purpose as a transitional form between the two-lane

(*Concluded on page 24*)

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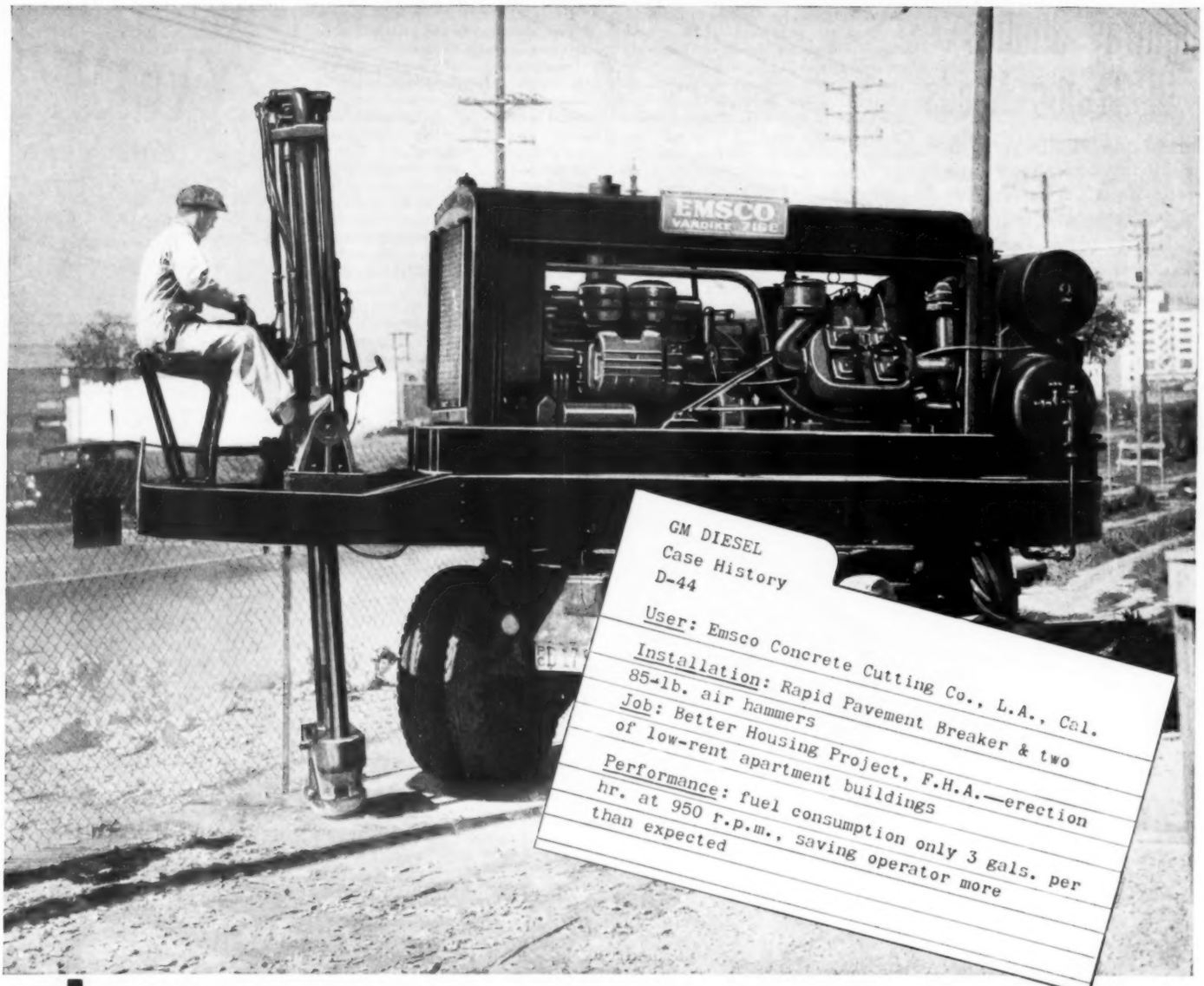
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D-44
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Job: Better Housing Project, F.H.A.—erection of low-rent apartment buildings
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The Toro Roadmaster Mower

Sickle Bar on Mower Driven Independently

A highway mower that is streamlined to make it attractive, can operate at 45 miles per hour when moving from one cutting job to another, and which has other interesting features, has been developed by the Toro Mfg. Corp., 3042 Snelling Ave., Minneapolis, Minn., as the new Toro Roadmaster mower. The sickle bar is driven by independent power which provides for greater cutting speeds and freedom from breakages caused by shocks and strains on the power take-off. This set-up permits the use of one lever for the power lift for the bar, which can be raised in 2½ seconds. The bar cuts at any angle from 90 degrees above to 60 degrees below the horizontal, which is worthwhile in sections where there are many steep slopes. The wide speed range from 3 to 45 miles an hour permits steady cutting in heavy grass and weeds and makes it easy to move the mower quickly in large counties or state highway divisions where work has to be done 40 to 50 miles distant.

The Roadmaster is powered with a 6-cylinder 60-hp Hercules engine with a 7-bearing crankshaft. The independent motor is a 3-hp 4-cycle Toro motor equipped with an automatic built-in mechanical governor that picks up the load instantly and keeps the pitman revolving at a uniform speed. The wheelbase of the mower is only 71 inches, giving it a short turning radius. It is equipped with a spring-mounted upholstered seat and standard controls and instrument panel. A new 16-page bulletin on the Toro Roadmaster is available free.

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Hot Weather Supplies Include Salt Tablets

With hot weather only just around the corner, contractors should include in their supply orders a generous stock of sodium chloride (common salt) tablets for their workers to prevent heat sickness. A new type of dispenser for supplying these tablets has recently been announced by Davis Emergency Equipment Co., 55 Van Dam St., New York City. It is made of black plastic, chemically inert to salt, and when a knob at the bottom is turned in either direction a single tablet is dropped into the palm of the hand.

When a dispenser of this type is mounted near the drinking fountain so that workers can take the tablets with their drinking water, it is particularly serviceable. There are two sizes, one holding 1,000 tablets and one holding 500. The smaller size is suitable for mounting on a truck serving field workers. For the individual use of field workers, booklets containing six tablets, individually wrapped in cellophane, are also available.

Salt is needed by men working in temperatures above 90 degrees Fahrenheit, either indoors or out of doors, because depletion of the body salt through excessive perspiration may cause heat sickness which is characterized by cramps, nausea, dizziness and general muscular exhaustion. From four to six 10-grain salt tablets a day should be taken to replace lost body salt.

New 2½-Mile Water Line Ordered for Bethlehem

Lancaster Iron Works, Inc., Lancaster, Pa., is now manufacturing 2½ miles of steel pipe of ⅜-inch wall thickness in 40-foot lengths for a new 20-inch water-supply line to be laid by Malone & Sons, contractor of Lancaster, Pa., for the Bethlehem Municipal Water Authority, Bethlehem, Pa. The new line will extend from Illick's Mill Pumping Station to the City of Bethlehem along Illick's Mill Road, Schoenersville Road, and Catasauqua Road to Pennsylvania Avenue.

The line is to be joined with flanges and Dresser couplings and when completed is to be tested under a pressure of 200 pounds per square inch with leakage not to exceed 200 gallons per 24 hours per inch diameter of pipe. Work is being done under a PWA grant. Robert L. Fox, City Engineer of Bethlehem, Pa., is the Engineer in charge.

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It's Tops Any Way You Test It

Mitchell Bros. Construction Co. Rolls Up Yardage in Rock and Dirt with Chain Crowd

LORAIN-40A

Test No. 1 Mitchell Bros. Construction Co., Birmingham, Ala., spotted this Chain Crowd Diesel Lorain-40A in a 3500 yd. rock cut on their Fayette-Tuscaloosa Highway contract. It averaged 900 yds. of blasted rock per 10 hours—used 2 gals. of fuel oil per hour.

Test No. 2 Then just to prove its versatility, this 40A moved over to a clay pit for 2 weeks. And did the dirt fly? 1500 yds. average production per 12-hour day with a maximum of 1930 yds.

Yardage figures like these tell you that the ¾-yd. Lorain-40A shovel has the power and strength to rough it in rock and plenty of speed to pile up big production in dirt. It's the 1939 edition of "America's Greatest Shovel Value" featuring Independent Chain Crowd, Center Drive design and a host of other profitable features—all of which are described in the new Lorain-40A catalog. Write for your copy today.

¾ YD. LORAIN-40A

THEW CENTER DRIVE

UNIVERSAL CRANE DIVISION • THEW SHOVEL COMPANY

LORAIN, OHIO

Well-Organized Dirt Moving At Hansen Dam in California

(*Continued from page 1*)

the job, and strangely the site from which the earth dam takes its name. The section of impervious material is continued as a blanket 10 feet thick under the two adjacent downstream zones, 3 and 4. This blanket is also rolled to maximum density. The same selected material is used in Zone 3, and in Zone 4 a pervious material is used while for the downstream and last section, Zone 5, a very open material is used. The downstream slope is 3 on 1 down to Elevation 1,050 where a 20-foot berm is constructed, then 5 to 1 to the next 20-foot berm at Elevation 1,020, then 6 to 1 to ground level where the dam ends in a rock toe.

Dirt Moving

Dirt moving is the major interest at Hansen Dam for there the largest quantities of any project now under construction are involved and also the newest in dirt-moving equipment is being given its work-out. These are the new Tournapulls, 25-yard self-powered Carryall scrapers, and the Gar-Bro Dragveyor, a machine which combines the digging power of the drag scraper with the loading features of the belt conveyor. The Tournapulls early in the work were used to move the impervious material from the pit located 500 feet from the upstream toe of the dam, while a fleet of diesel-powered Sterling trucks were being loaded with pervious material by the Dragveyor.

The Tournapull is mounted on a pair of huge pneumatic tires for maximum traction to pull the great body with its load of 25 cubic yards loose, or about 17 cubic yards place measurement. For loading, the machine requires two tractors, one at the back pushing with its reinforced bulldozer and another at the front attached to the dirt-moving machine by a novel hitch controlled by the front tractor operator. This was developed on the job to save the time of a man to hitch the front tractor which was needed most of the time because of the very poor traction in the sandy material. The hitch consists of a triangular loop suspended in front of the Tournapull and comprised of a heavy welded bar. The weight of the loop is carried by a counterweight running in leads mounted in front of the radiator and the pull is transmitted to the earth-moving unit by two heavy cables attached to the frame close to the axles. The counterweight maintains the height of the loop at an elevation where it can be readily picked up by a heavy hook on the back of the pulling tractor. The elevation of the hook is changed by the winch on the back of the tractor. The tractor operator swings the pulling tractor in front of the Tournapull and drops the hook to the right elevation. It quickly engages the loop and the combination is off with the rear tractor adding its power to the D17,000 engine of the scraper.

The Tournapulls are used for hauling up to about 1½ miles with an average of 1 mile while the fleet of eight to ten

C. & E. M. Photo

Atkinson's Grease Truck Starting Out from the Yard to Make a Round of the Automotive Equipment Once Each Shift

Cummins-powered Sterling trucks with 16-yard bodies work the longer hauls, averaging 1½ miles. The fleet of twelve Tournapulls was making the rounds from borrow pit to borrow pit with a ⅝-mile haul one way in an average of 15 minutes at the time of our inspection.

The two borrow pits already opened cover about 100 acres and more will be used as required. The change from the pervious to impervious material occurs at a street line making the division readily understood by ambitious operators. Both excavating outfits are working three 7½-hour shifts for six days a week, the Tournapulls hauling an average of 18,000 yards per day and

(*Continued on page 30*)

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INSULATED HAVOLINE MOTOR OIL

Getting Organized On Alaska Road Job

Distance from Supplies, a Mired Tractor and Weather Were Some of Difficulties; Airplane Saved the Day

By HAWLEY STERLING, Assistant Chief Engineer, Alaska Road Commission

✦ AS any construction man knows, the most difficult part of a job is to get organized. Once that is accomplished, the actual work becomes routine in the hands of a competent supervisor. Getting started in the States where wants can be communicated over the telephone and served by high-speed delivery is very different from starting a job in Alaska which is located 250 miles by air from a base of supplies, materials, shops and men. Other difficulties involved in road building in Alaska are the climate and the peculiarities of the terrain, as is illustrated on one 22.5-mile job tackled last year.

Reason for New Road

The Ophir Mining District, discovered in 1911, is located in west central Alaska where tributaries of her two great rivers head close together. During the early stages of development, supplies were brought from Seattle to St. Michael at the mouth of the Yukon, thence by river steamer to Holy Cross and there transferred to a smaller steamboat for shoving up the Innoko. When the little boat could push its shallow-draft flat-bottom barges no further, the freight was unloaded onto horse scows which dragged it up the swift stream to its destination at the town of Ophir. Packs on the backs of horses and men were the means of final distribution.

It is 22 miles from what was considered the head of small-boat navigation on the Takotna River, a branch of the Kuskokwim, to the town of Ophir on the Yukon watershed. The Takotna under average conditions is a better stream for small craft than the Innoko so in 1920 a wagon road was started, with the idea of supplying the district from the Kuskokwim River. This road was completed in 1926 and has since been improved for use of trucks carrying up to 5-ton loads.

In dry seasons, of which there are many, the Takotna River has proved unsatisfactory. Frequently freight delivered at McGrath late in June was not landed at Takotna until autumn. With the impetus given to gold mining by the increased price and more up-to-date methods, the Ophir district is having a revival. Large quantities of heavy machinery and thousands of barrels of fuel oil are being moved each summer. A cry went up for some means of transportation by which the district could be supplied promptly after the first river boat comes up the Kuskokwim River about June 25.

Consequently the Territory made an appropriation last autumn to investigate, survey and, if found feasible, to start the construction of a road from steamboat transportation to connect with the existing road between the towns of Takotna and Ophir.

Reconnaissance trips were made over all possible routes. The one finally selected was surveyed before October 1. This route cut across the drainage of the Takotna and Tatalina Rivers and hit the big river at a point 23 miles downstream from the town of McGrath, which is called the head of steamboat transportation. The route also passed through the only existing mining property in that vicinity other than those for which it was headed. This property being only 8 miles from the river and directly along the route, it followed that this section should be completed at the earliest possible date to afford some relief to the miners who had been dragging their fuel oil over the swampy bottomland of the Tatalina River valley.

It must be remembered that except for this one section the entire route was through raw country, without trails or habitations. Except for two valley crossings, the 22.5 miles, covered with birch and spruce growing in good road soil or slide rock, were ideal for road work.

Getting Organized

There was no equipment located on the Kuskokwim River or elsewhere in the vicinity, except for a Caterpillar Forty and a D7, both equipped with bulldozers, which were owned and being used by the mining company. Free use of this equipment was offered, beginning at the end of the mining season but at that time dirt-moving activities were practically at an end because of the

(Concluded on page 35)

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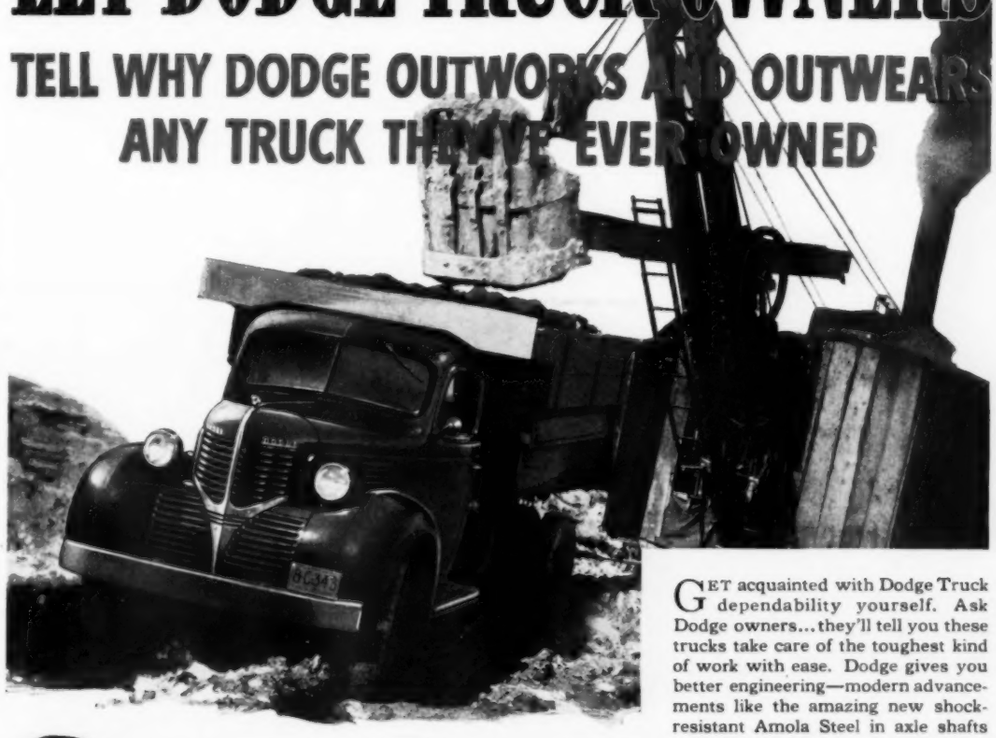

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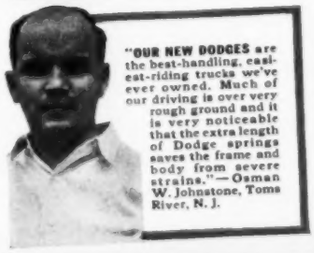
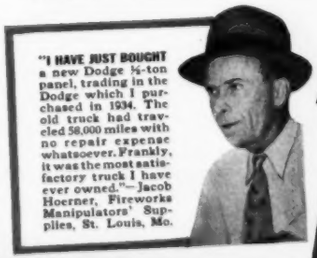


"OUR NEW DODGES are the best-handling, easiest-riding trucks we've ever owned. Much of our driving is over very rough ground and it is very noticeable that the extra length of Dodge springs saves the frame and body from severe strains."—Osman W. Johnstone, Toms River, N. J.



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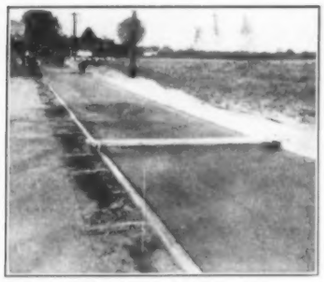

Heltzel Stake Braces in Use on Pavement Widening

Braces for Setting Forms on Old Paving

The Heltzel adjustable stake brace for setting steel road forms on an old hard-surfaced pavement when re-surfacing with concrete or bituminous material is made in two sections, one of which telescopes within the other, and is provided with a 1-inch diameter dowel which fits into the regular road form stake pocket. The brace is then extended to the proper length so as to permit driving stakes beyond the edge of the existing pavement. If any obstructions are encountered, stakes may be driven at any point on a radius described by the length of the brace. According to the manufacturer, this combination brace and staking arrangement will hold the forms firmly in place under the heaviest finishing-machine equipment. Two slots for stakes are provided in order that these braces may be used under any conditions. One is elongated for flat stakes for driving between the bricks on an existing pavement and the other is a 1-inch diameter hole for the round stakes. Not only will these braces eliminate the necessity for drilling holes through the old road surface but it is claimed they make it possible to set and align forms in approximately one-half the usual time.

Complete information is contained in Bulletin T-27-B which also contains illustrations of typical installations on several different types of existing pavement. Copies of this bulletin may be secured direct from the Heltzel Steel Form & Iron Co., Warren, Ohio, by mentioning this item.

New Branch Office for Pneumatic Tool Co.

The Independent Pneumatic Tool Co., Chicago, Ill., has recently opened a branch office at 1544 Broadway, Denver, Colo., with C. A. Turnquist in charge. This branch will render complete sales and service assistance on the company's lines of Thor-Cochise contractors' and mining equipment and Thor portable electric and pneumatic tools.

New Sales Mgr. Appointed

The Stewart-Warner Corp., Chicago, Ill., announced recently the advancement of Fred R. Cross to the position of Sales Manager for the Alemite Retail Sales Division. Mr. Cross, who has been connected with this corporation for the last 15 years, held the position of Director of Advertising for Stewart-Warner and subsidiaries for six years prior to this promotion.

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Level is easily and quickly attached to line. Special feature construction prevents accidental detachment from line. Construction is sturdy, and accuracy guaranteed.

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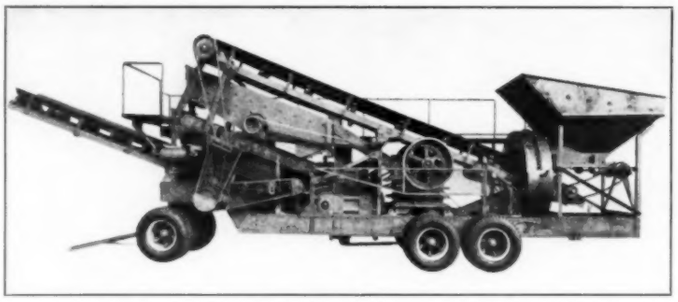
New Aggregate Plant Put Through Paces

The new Telsmith dual portable crushing-screening-loading plant was put through its paces recently at a three-day preview at the factory of the Smith Engineering Works, 4014 No. Holton St., Milwaukee, Wis. There were visitors from Minnesota, Michigan, Illinois, Iowa, Ontario, as well as Wisconsin, who watched the plant and commented on its design to meet contractors' requirements. The new unit weighs 50,000 pounds, is 41 feet 8 inches long and 8 feet 10 inches wide, which constitutes a real reduction in size accomplished by the use of a rotary elevator. Telsmith does not claim the credit for this invention, which has been used on portable rigs by the Yager Construction Co., Fond du Lac, Wis., and Koplin-Kinas, Green Lake, Wis., as well as other Wisconsin contractors, for a number of years. Its efficiency as a means of reducing weight and bulk of portable outfits was the reason that Telsmith has adopted it in its new portable rig.



The New Telsmith Dual Portable Crushing-Screening-Loading Plant

Five chain drives have been eliminated in this plant and replaced by belt drives to secure smoother, quieter operation and lower upkeep. In addition to its two crushers, a 9 x 36-inch roller-bearing Telsmith jaw crusher and a 30 x 18-inch Telsmith roller crusher, the plant includes a hopper with grizzly, a plate feeder, four conveyors with anti-friction bearings, a 3 x 10-foot 2½-deck Telsmith vibrating screen, the rotary elevator, a sand reject conveyor, and the operator's platform with the controls centralized, permitting one-man operation. The whole outfit is equipped with pneumatic-tired roller-bearing wheels and Bendix brakes. Descriptive literature and further information may be secured from the manufacturer.

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LEADERS IN DRILLING EQUIPMENT

Asphalt and Coquina Stabilize Sand Road

Progressive Work on Road On Anastasia Island, Fla., Provides New Artery Along Atlantic Coast Beaches

✦ FLORIDA Route 140 starts in the ancient city of St. Augustine and plays touch and go with the beaches for over 300 miles down the Atlantic coast to Miami Beach. Close to St. Augustine, on Anastasia Island, a 4.7-mile project of new construction of sand-bituminous road-mix pavement was developed as a WPA project, the Works Progress Administration furnishing the labor, St. John County the equipment, and the State Road Department of Florida the asphalt and supervision of the mixing operations. Work on this was started in the summer of 1937 with stabilization in 1938.

Original Work

The new location of Florida 140 on Anastasia Island was cleared and graded by WPA forces in the spring and summer of 1937 and then the state maintenance forces went in to work about 3 miles of the project, first applying 5 gallons of cut-back asphalt, with a base penetration of 45 to 60, per square yard to the sand. The sand was a very fine-grain beach sand mostly passing an 80 and retained on a 100-mesh screen and perfectly round. The grade of the sand was the reason that an asphalt as hard as a 45 to 60 penetration was used. The sand and asphalt were mixed with spring-tooth harrows and disk harrows, and two pulled graders. After about 2.75 miles of this road had been treated and traffic had been turned on it, it was found that under moving traffic the road surface was entirely satisfactory, but if an automobile stopped for a short time it would settle into the pavement so that it was lucky to be able to get out without help. As long as the vehicle was moving the road surface would show no marks at all, and no wear was visible.

Stabilization with Coquina

It was decided to endeavor to stabilize this section of the project with coquina rock. Coquina rock, as known in northern Florida, is a deposit of very small shells similar to the snail or periwinkle, and these deposits occur all along the coast. The original road was graded out to about 4 inches below grade and filled in with the 4 inches of shell spread uniformly. Then a 22-inch disk harrow was used to mix the shell and the sand. After it was thoroughly mixed, asphalt was applied and the whole mixed with the disk harrow, spring-tooth harrows and pulled graders. When this stretch of road was finished and had dried out for about 3 weeks, it was found that the pavement had set to such an extent that it was possible to park a car on it for a reasonable time without showing any appreciable settlement. It was then decided to go back and stabilize the part of the road which had been finished with only the sand and asphalt.

Stabilizing the Main Project

On the main project, when the stabilizing was started, the coquina was first hauled in and dumped in windrows along the shoulders. Then a scarifier was used to tear up the sand-asphalt pavement to a depth of 3 to 4 inches. The scarified pavement was thoroughly cut up with disk harrows until free from lumps. The windrows of shell were then pulled in with a grader and tractor, care being taken to have an even distribution of shell over the entire width of pavement. Following this the asphalt was applied and the mixing was carried on in the same manner as before on the regular mix. On this section from 0.75 to 1.00 gallon of asphalt was used to the square yard in the stabilizing process. When the mixing was completed, the pavement was rolled with a tandem roller until no roller marks showed. It was then planed with a 12-foot grader pulled by a tractor with a smooth track to remove ridges and, following this, the rolling was continued until no further roller marks showed on the road.

On about 2 miles of the re-mix, wet cold weather stopped the work and it was left after being shaped up. Traffic used it during this time until about the middle of March, 1938, when the state maintenance forces went back and finished the job. On this particular stretch of 2 miles the shell had been mixed in and approximately 0.75 to 1.00 gallon of the asphalt had been applied before the rains came. On the final mixing this section was again scarified, then 1.00 to 1.25 gallons of asphalt added and mixed in the usual way with no essential change in the method.

Sealing

The surface, which was rather open, was sealed with the same asphalt applied at the rate of 0.2 gallon per square yard, which appreciably softened the top ½ inch of the pavement. No blotter material was applied and the surface was left to cure for at least two hot dry days without traffic. Then, as the surface hardened sufficiently, traffic was permitted to use the road. To complete the work, the waste material at the edges was bladed with the excess

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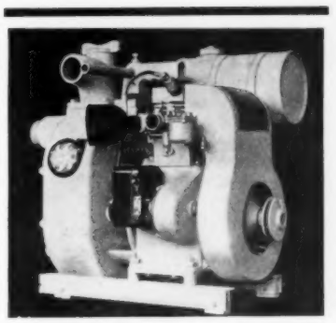

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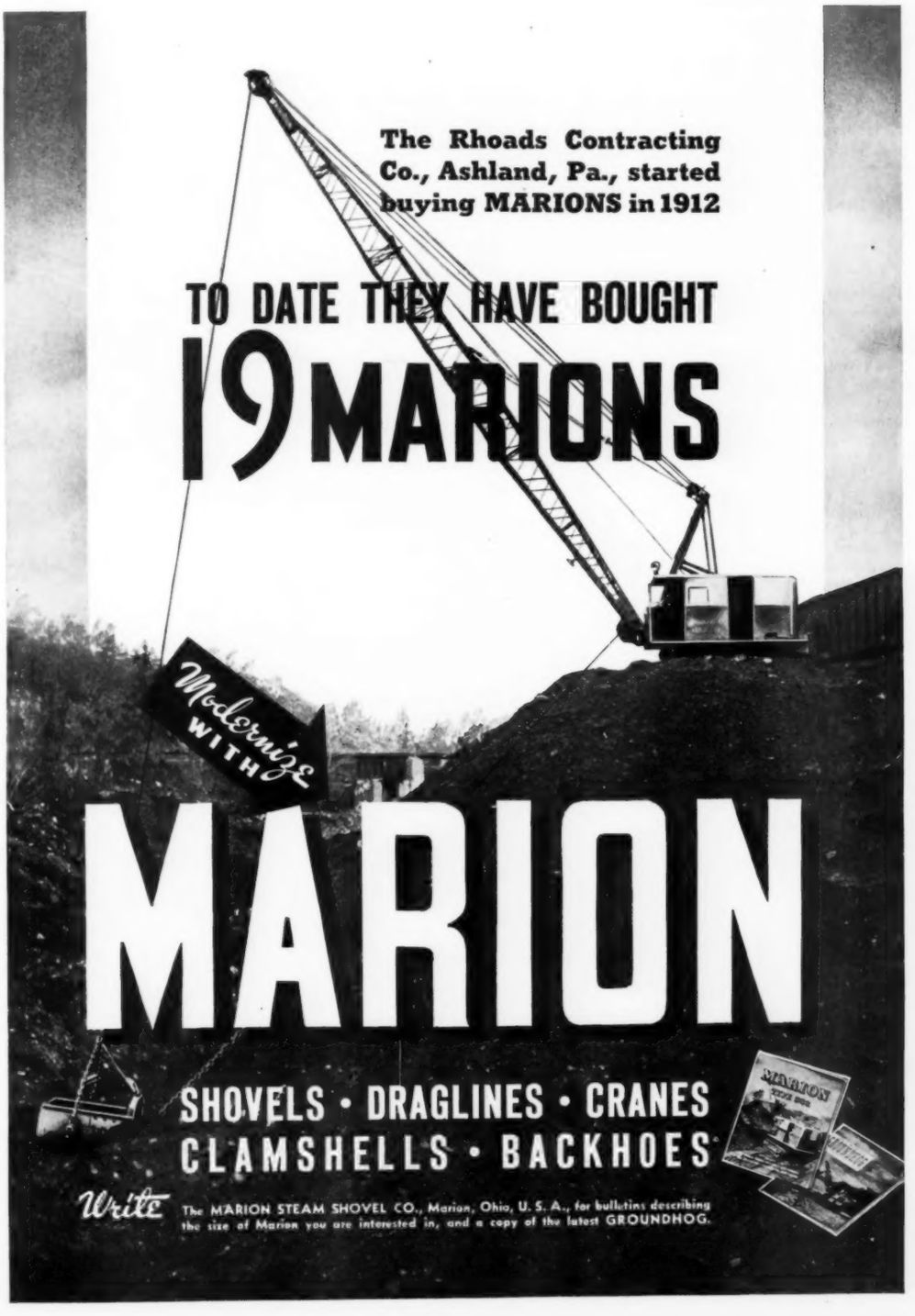
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Frost Boils

(Continued from page 2)

presses against the thin absorbed water film surrounding a soil particle, but this film is under very high pressure and the ice crystal cannot "squeeze out" the water. Instead there is a transfer of molecules from the film to the growing crystal. As molecules leave the film it tends to become thinner, but in doing so the pressure increases, resisting the pressure of the crystal and actually tending to push it away. To maintain equilibrium of pressure, water flows into the film towards the contact point with the crystal. This flow is made possible by the very high cohesive forces between the water molecules, and thus water is under very great tension.

As the crystal grows, water flows to the film from below and its thickness is maintained. In this manner crystallization proceeds, forming ice layers which separate and heave the soil. If the frost line remains at this elevation, or more specifically, if just enough heat is conducted upward from below to maintain the prevailing temperature in the water and to remove the latent heat of freezing, the ice layer continues to grow indefinitely, provided, of course, that water is supplied at a sufficient rate from below. Under proper conditions, an ice layer may grow very thick. However, such an equilibrium condition is usually not maintained very long, due to changes in air temperature above the ground. Then if heat is conducted away more rapidly, the frost line or isothermal line of freezing moves downward and the temperature is lowered sufficiently at a point lower down in the soil to cause ice crystallization to start, and a new layer begins to grow.

This layer cuts off the supply of water to the layer above and its growth stops. The soil in between the two ice layers contains water which only partly freezes as the temperature is lowered. Now the starting of a new ice layer may also be caused by water not being supplied to the crystals rapidly enough to maintain thermal equilibrium. If water cannot flow to the adsorbed films, or if the mobility of the water in the films is small because of high viscosity, the large pressure produced in the films may lower the freezing temperature so much that crystallization starts lower down, at a higher temperature where water is under less pressure, and a new layer is formed.

Figure 1 illustrates the structure of a frozen ice-stratified clay. At the right, a vertical section of a typical sample is shown and the corresponding water content at each level before and after freezing is shown at the left. Zone A represents the frozen soil with ice strata of varying thickness. Zone B represents the "dried out" zone, and its decrease in water content is shown graphically at the left. Since, in clays, freezing is accompanied by large pressures due to the reduction in thickness of the adsorbed water film, these films squeeze the clay together and it is actually compressed, the moisture being lost to the freezing zone immediately above. This drying out induces cracks to form just below the frost line in which crystallization starts as the frost line moves downward. At the left of the diagram the distance between the solid and dashed lines represents the increase in water content due to freezing. The thickness and distribution of the water in the form of ice layers is controlled largely by the rate of freezing. If the frost penetrates very slowly and the frost line remains relatively stationary, thick ice layers are formed, and vice versa. It can be said that the distribution of ice in a soil is a reflection of the variation in the ground surface temperature as this controls the rate of freezing.

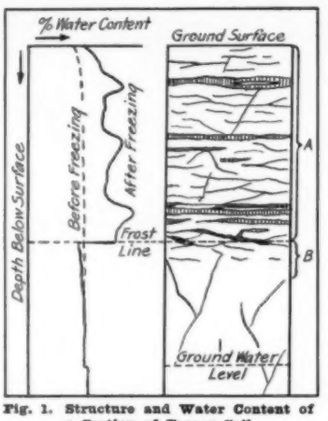


Fig. 1. Structure and Water Content of a Section of Frozen Soil

Character of Soil and Heaving

Though the many factors affecting the way soil freezes and the magnitude of heaving are complicated and involved, this brief discussion would not be complete without at least considering them.

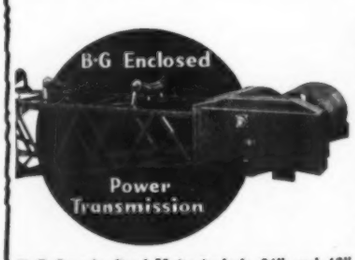
As already stated, coarse soils freeze homogeneously and have no appreciable heave. The dividing line between frost heaving and non-frost heaving soils depends, of course, on various factors but experiments have shown that the size of the soil grains is a fairly good criterion. For soils of uniform grain size, Beskow found that no heaving occurred for grain sizes greater than 0.1 mm (fine sand). Casagrande states that for a graded soil, if there is less than 3 per cent of material smaller than 0.02 mm. (coarse silt), the soil will not heave.

Experiments on the rate of heaving show that the fine silts heave the most. As you go from coarse to fine silt the heaving rate increases very rapidly and reaches a maximum. Then as the grain-size decreases further (lean clay), the rate decreases gradually until for the very stiff colloidal clays there is no appreciable heave. Clays heave little because their permeability is so small that water cannot flow readily to feed the growing ice layers.

Since heaving depends on a supply of water from below the freezing zone, the capillarity of the soil and the depth to ground water have a very large effect on the amount of heave. If the depth to free ground water is greater than the capillarity of the soil (the height to which water will rise by capillary flow in a column of soil), there can be no flow from the ground water and there-

(Continued on next page)

Via Barber-Greenes



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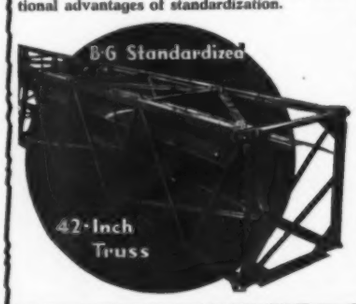

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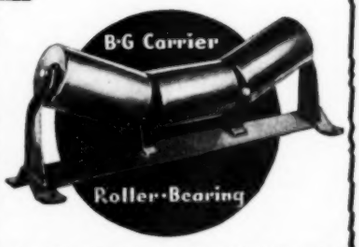

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Frost Boils

(*Continued from preceding page*)

fore no heave. If the depth to ground water is less than the capillarity, the rate of heave decreases very rapidly as this depth increases. Therefore in many cases frost heaving can be decreased to a neglible amount only by lowering the ground water table several feet.

Effect of Frost Heaving on Roads

The damage to roads from frost heaving may be due to the actual heave produced, or to the secondary effect of the softening of the road bed from thawing. If heaving is uniform over an area, the heave itself would not cause any trouble as the road would lift up as a whole. It is the differential heave that is troublesome for it can make the road uneven and hazardous to traffic, and can crack and break up rigid pavements. Differential heave is caused by varying soil composition, varying ground water conditions, varying depths to bed rock, and varying heights of fills and depths of cuts. A striking example of differential heaving is over culverts. Directly over a culvert there may be little or no heave because the frost has not penetrated to the soil below it, while just adjacent there may be considerable heave. A little gully or rut across the road is thus formed which can be quite damaging to traffic. Sometimes a culvert is lifted up by the heaving of adjacent soil, and when this soil has thawed and settled, the culvert may not settle back in place, which then causes a bump in the road.

A common type of damage from differential heave is the lifting of the crown of a road. When the snow has not been completely removed but just thrown aside, covering the ditches and the sides of a road, it acts as an insulator and retards the penetration of frost. In the center where the road is cleared, the pavement is a good conductor, and the frost penetrates much deeper than at the sides, causing more heave in the center. It is quite common to see the slabs on concrete highways tilted, with corner breaks, and the longitudinal joints opened up. Most of this damage can be prevented by careful snow removal. The snow should be cleared from the road completely and from the shoulders if possible. Another procedure in snow removal which helps in preventing frost damage is to remove completely the first snowfall during the late fall cold spell. The frost can then penetrate the upper portion of the road bed rapidly, allowing the thick ice layers to grow lower down. Thick ice layers lower down are much less harmful than near the road surface when the spring thaw comes.

The secondary effect of softening of the road bed during thawing causes the most damage to roads. As water is released from the frozen ice layers during the spring thaw, and is prevented temporarily from draining away by the still frozen layers beneath, the bearing capacity of the road bed is reduced, and a heavy wheel load may exceed this capacity and cave in. Where the ice layers are excessively thick, melting may cause "frost boils." These are spots where the water content of the soil is above the liquid limit, and the soil is in a liquid "soupy" state, being able to carry no load at all. Flexible pavements will yield and form holes and bumps in such ground. Rigid pavements may bridge over the boils and soft spots or may crack from excessive bending moments.

Where on roads would one expect to find dangerous heaving? The importance of depth to ground water has been discussed, and it is obvious that we may expect heave where the depth is the least. Thus, in general, heaving occurs most in cuts and least in fills since in cuts the road bed is brought nearer to the ground water table, which to a large degree follows the conformation of the ground surface. On sloping ground, where there is part cut and part fill, the heave may be very large on the inner side of the road and small on the outer or filled side, causing a tilting of the road bed which may even be perilous to traffic. Excessive heaving and frost boils may occur in spots where the road is quite level and does not pass through cuts or fills. Here one usually finds that at these places the bed rock or impermeable layer is higher than elsewhere and the ground water surface is thus made higher, bringing it closer to the surface (Figure 2). In places of high ground water where fills are made of heterogeneous material dumped in at random, and care is not taken to eliminate dangerous frost heaving material from the fill, large differential heaving may occur.

Prevention of Frost Heaving

Practical methods of preventing damage from frost heaving are numerous and no specific rules can be given, because the amount of heave, damage experienced and control required vary so considerably. However, the following general principles can be used to diminish or prevent frost heaving.

1. Lowering the ground water table to diminish or entirely prevent heaving.
2. Prevention of upward flow of

(*Concluded on page 33*)

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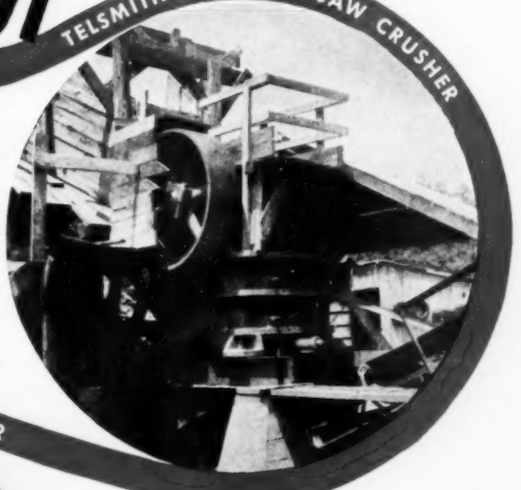
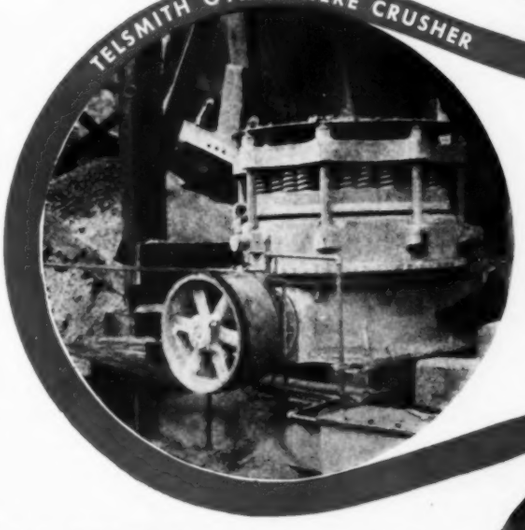


TELSMITH GYRASPHERE CRUSHER



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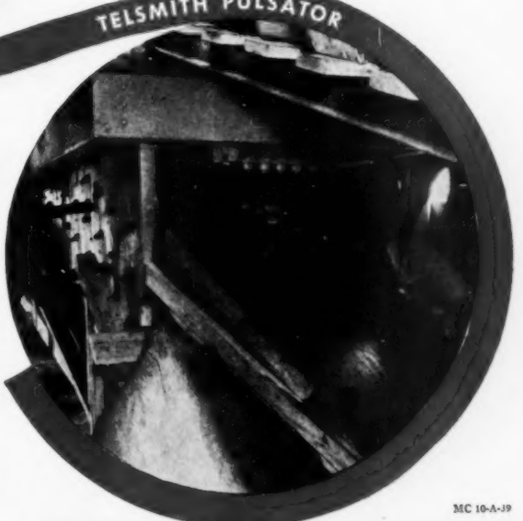
TELSMITH PULSATOR



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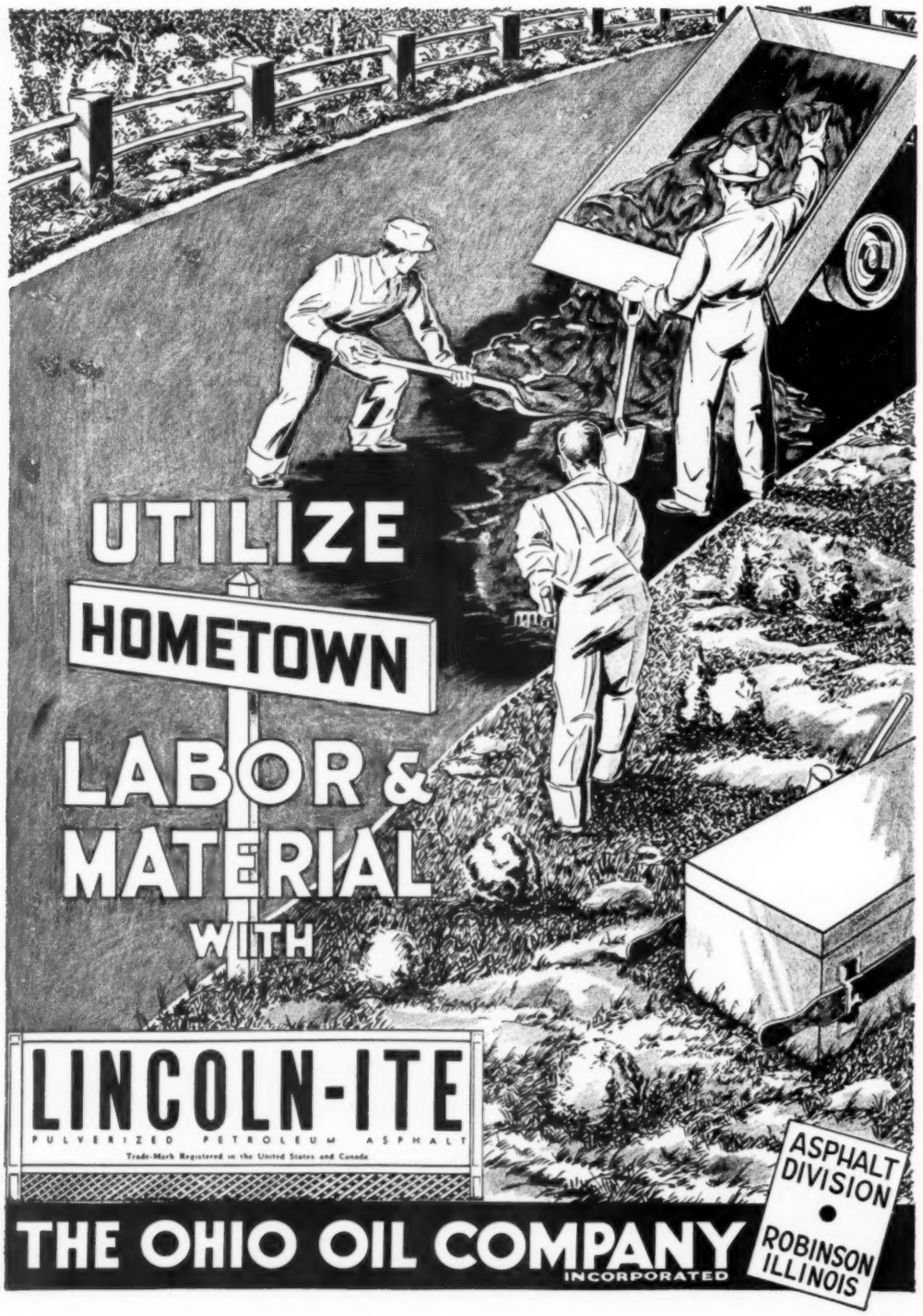
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Concrete Base Laid With Shell Aggregate

Gulf Bitulithic Co. Completes Job With Asphaltic Concrete Surface On South Texas Road

✦ TWENTY-FIVE miles east of Houston, Texas, the Gulf Bitulithic Co. of Houston recently completed an asphaltic-concrete surfaced road 5 miles in length, using oyster shells for coarse aggregate in the 9-6-9-inch section of the 20-foot concrete base. The work was on State Highway 146 in Harris County from the Town of Pelly to Cedar Bayou. The roadway has an 8-inch center strip of white monolithic concrete raised ½ inch above the base to equal the thickness of the adjacent 50-pound per square yard asphaltic-concrete surfacing.

The Aggregate

Oyster shells are abundant in this section, making the economy of this "local material" worthy of serious consideration. The shells are dredged from bays or the Gulf, washed to remove the mud, and then screened to remove all shells over 2½ inches in longest dimension. Revolving and vibrating screens with 2½-inch round holes are used for this purpose. The shells are not crushed because the average size is small enough, but the conchoidal form does make for water pockets which create voids, and hence a weakness in the cured slab. The soft aggregate reduces the effectiveness of this type of concrete for a wearing surface, but the City of Houston has used it effectively for streets with a ¼-inch monolithic mortar finish.

Another disadvantage is the tendency of the water in the mix to work quickly to the surface because of the harshness of the aggregate. No trouble was experienced on this particular job under the finishing-machine screed, but floating or troweling drew the water rapidly. The greatest trouble was met on widened curves where the whole progress was slowed up, and the spiraled curves and super-elevation aggravated the free water problem.

Running the Job

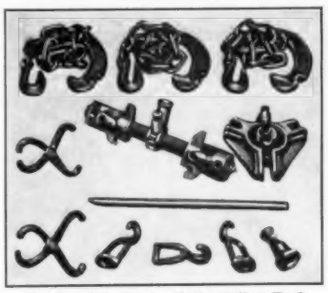
The concrete mix was designed for 375 to 425 pounds per square inch flexural strength in 7 days. The average mix contained 2,000 pounds of sand, 1,500 pounds of shell and a cement factor of 4.66, with 10.75 gallons of water per sack of cement. The concrete was mixed 1¼ minutes in a Rex 27-E paver, then screeded with a Lakewood finisher and hand-floated for the final finish. A continuous tape, to create a plane of weakness, was inserted 4 inches off center so as to clear the white stripe, and then the full surface covered with wet cotton mats and cured for 72 hours.

A shell shoulder was spread the full depth of the pavement and base so that all free water could drain rapidly away from the pavement to the ditch and not stand at the edge of the pavement.

We are indebted to C. F. Weddington, Resident Engineer, District Office, Texas Highway Department, Houston, Texas, for the information contained in this article.

Portable Compressor Catalog

Schramm, Inc., West Chester, Pa., has recently issued a new 22-page catalog presenting its complete line of Utility portable air compressors which are available in sizes from 85 to 420 cubic feet capacity with either gasoline or diesel engine power and a variety of mountings. Operating data, detailed specifications and pictorial design features are included. Copies of this catalog, 3900-CY, may be secured by those interested direct from the manufacturer.



The Various Parts of the Util-A-Tool

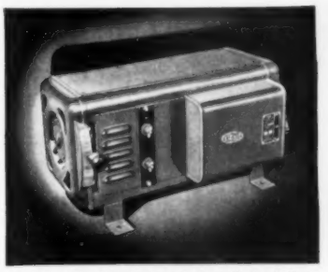
New All-Service Tool For Maintenance Jobs

A new multiple tool which can be used for spreading or pulling together structural members or any movable objects within its 10-ton capacity, for pushing, hoisting, lifting, lowering, clamping, bracing and tensioning, has been announced by Templeton, Kenly & Co., 1020 S. Central Ave., Chicago, Ill. This new tool, the Util-A-Tool, comes in a compact metal carrying case with complete instructions and suggestions for its use.

It can be used quickly to remove gears, wheels, pulleys and diesel marine propellers, according to the manufacturer. It is available in five sizes at the present time and literature may be secured on request by mentioning this item.

Double-Duty Welding Unit Uses Gas and Electricity

A double-duty gas and electric welding unit which combines a P & H-Hansen 150-ampere portable welder made by the Harnischfeger Corp., Milwaukee, Wis., and gas equipment distributed by Young Sales Co., Inc., Milwaukee, Wis., has just been developed and placed on the market by the latter company. The electric welding unit is coupled to a Wisconsin air-cooled motor mounted on the standard P & H trailer. In connection with this unit is a complete gas welding and cutting outfit with a 6-P Sight Feed acetylene generator to provide the acetylene, while a special bracket is arranged to carry either a large or small tank of oxygen.



A New Combined Electric and Acetylene Welding Unit

This combination is adaptable for practically all ordinary work and offers the welder great economy because of its portability. It should have wide use in the construction field for maintenance and repair work.

NEW

the modern 2-yard leader shovel-dragline-crane

The Bucyrus-Erie 44-B offers you performance that means new highs in profit on your excavating. From dipper teeth to cats, it's MODERN. All the skill of the biggest, most experienced engineering staff in the industry; all the resources of the largest excavating machinery manufacturer in the world, have been concentrated on giving you the best possible earning tool. If you're interested in a 2-yard shovel-dragline-crane, write for the new 44-B Bulletin and find out why it's far and away the top machine in its class.

BUCYRUS ERIE

Bucyrus-Erie

SOUTH MILWAUKEE, WISCONSIN

Drainage Important On County-State Job

(*Continued from page 1*)

Drainage Structures

The drainage structures on this work consisted of several reinforced concrete box culverts ranging from a single 3 x 3-foot to double 4 x 3-foot boxes. One and two 18 to 24-inch concrete pipes were used for ditch drainage beneath access and cross roads. Depending on the volume of flow, they were installed with or without header and wing walls. With one exception the bridges on the project are creosoted pile, deck and wing walls having 16-pound treatment. The ditches and backslopes were all cut by blade and by hand, with the exception of some work in the south end where a Northwest dragline was rented for a short time to remove excess material.

At the canal crossing the drainage from the ditches is carried directly to the canal down grassed ditches and through concrete spillways. The great problem was the matter of disposing of the water after it gathered in the side ditches. As the country is very flat exceedingly long lateral ditches are required. The shortest lateral is 2,000 feet and the longest is 4,600 feet on a grade of 0.1 foot per 100 feet. This ditch cares for the water from 2 miles of road.

The side ditches are 2½ feet deep and from 8 to 15 feet wide at the bottom with wide front slopes of 6 to 1 or 4 to 1 and back slopes varying from 1 to 1 to about 4 to 1. The shoulder slopes are 1 inch to 1 foot.

Grading and Base Course

The work was started in Foley between two 10-foot surface-treated strips and a valley gutter. The subgrade was cut 24 feet wide with a No. 10 Auto Patrol grader and bladed to the side for shoulder material. The base material was then hauled in and piled along one side of the roadway, knocked down with the patrol or a Galion 10-foot blade pulled by a Caterpillar Sixty. Not later than the following day, the base was scarified for the full depth of 6 inches, remixed with a disk harrow and blade to give a uniform material and then reshaped with a crown of 1/3

C. & E. M. Photo
A 4,600-Foot Lateral Ditch Cares for the Drainage of 2 miles of Road

inch per foot. Traffic was then allowed to compact the base for a minimum period of 30 days. During the last 5 to 10 days of traffic compaction, the base was bladed to template for as close an approach to a perfect crown as possible. Brush was used along the center line of the base course during traffic compaction to force vehicles to the edges instead of allowing them to run down the center of the road as is the usual habit of most drivers. As the first loose material was placed, one man followed the blading and pulled out all remaining roots and this was repeated as the disking proceeded. Also during the traffic compaction the base was watered judiciously to insure the maximum of compaction and to prevent the material from being whipped off the road by traffic.

The base-course material was hauled from a large pit about 2 miles off the job, making an average total haul of about 5 miles. This base course is 2 inches thinner than Alabama standard practice calls for because the subgrade material so closely approached base material specifications. On the south end of the project, however, there was 3,000 feet of sand of poor bearing quality so that 12 inches of top soil was hauled in and compacted by working with a Caterpillar D6 and Caterpillar 10-foot blade before the base material was placed. In the pit from which the base-course material was hauled the county ⅝-yard P & H 400 shovel moved an average of 1,296 yards in 12 hours, working against an average 9-foot face and up to a maximum of 12 feet. With an adequate supply of trucks and the loose material the operator had things running nicely.

For watering the base course during the traffic compaction and also for watering the shoulders after the grass had been placed, a pair of two-tank trucks was used with offset spray bars to reach out over the shoulder.

The project called for a 30-foot roadway including the shoulder. This extends 3 feet beyond the base course on either side and 5 feet beyond the surface.

(*Concluded on page 39*)

When you replace an old type ½ yd. machine weighing 43,000 lbs. with a ½ yd. P&H that weighs only 22,000 lbs., you'll find reason, too, for enthusiasm! "Of all welded construction," says Mr. Lunder, "there has never been a sign of anything getting loose in the framework, and the gears and shafting run very smoothly which would indicate that they are rigidly supported by the frame." That's one of the big advantages in P&H design. It saves time, saves repair bills, cuts production costs. That's why Mr. Lunder's next machine was another P&H. Thousands of alert contractors have proved these things. Why not you?

P&H EXCAVATORS 18 Different Sizes From ⅛ to 5 cubic yards Capacity; Gasoline, Diesel or Electric Power

Write for literature on the size and type that interest you. Address the Harnischfeger Corporation, 4419 West National Ave., Milwaukee, Wis.

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EXCAVATORS • ELECTRIC CRANES • ARC WELDERS P&H HOISTS • WELDING ELECTRODES • MOTORS

LATEST IN HOISTS

30 to 50 H. P. JAEGER HOISTS NOW OFFER

- Touch Control thru Giant Expanding Frictions or Clutches.
- Timken Self-Aligning Bearings.
- Combined Side Frames and Base, All-Steel, Lighter, Stronger.
- Self-Starters, up to 8 Cyl. Power, many Jaeger improvements — all at ASTONISHINGLY LOW PRICES!

OTHER SIZES 10 TO 100 H.P. — Most modern hoists on market—single, double, three drums, gas or electric. Send for Catalog.

THE JAEGER MACHINE CO.
701 Dublin Ave. Columbus, Ohio

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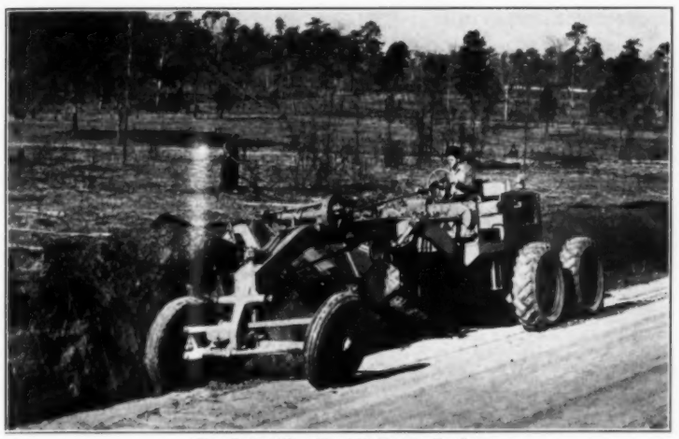

The Caterpillar No. 112 Power Grader

Smaller Power Grader In Heavy-Duty Class

A new power grader which is a smaller edition of its No. 12 grader, with a wide range of blade positions, adequate weight and power, removing it from the maintenance class and making it a heavy dirt construction machine, has been announced by Caterpillar Tractor Co., Peoria, Ill. Called the No. 112, the new machine is available with either a gasoline or a diesel engine, with four cylinders developing 46 hp at 1,500 rpm.

The 12-foot blade will reach more than 6 feet outside the line of wheels and can be set to cut banks up to 90 degrees. The blade can also be turned completely around. In the reverse position the blade can be set for ditching or blading, permitting working back and forth on one side of a regrading job without turning the machine around. Changing the blade from the forward to the reverse position takes only half a minute with the mechanical power controls.

Four forward speeds with a low of 1.8, two intermediates of 2.7 and 4.3 and a high of 10 mph, as well as a reverse of 2.4 mph, are available. Low-pressure-tired tandem or single drives are available. With the diesel engine and tandem drive, the No. 112 weighs 17,800 pounds, with more than 13,000 pounds of this weight carried by the driving wheels.

Attachments for the new motor grader include a V-type scarifier, a straight-type scarifier, a V-type snow plow and a roller. Standard equipment includes leaning front wheels and two braking systems, one hydraulic and the other mechanical. Form 1823, giving complete specifications, will be sent by Caterpillar immediately to those writing and mentioning this item.

Portable Electric Tools

The complete 1939 line of Thor portable electric tools is described in a 48-page catalog recently issued by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. The book, which is divided into four sections, gives complete descriptions, specifications and prices of the entire Thor line of electric drills, drill stands, screw drivers, nut setters, tappers, saws, hammers, grinders and electric tool accessories. Featured are the Thor U14A series of 3/16-inch and ¼-inch drills, the U44 ½-inch drills and the U16A series of screw drivers. A copy of this catalog may be secured by those interested direct from the manufacturer.

Book on Subdrainage Pipe

A new 32-page book on subdrainage, written in text book style, and which justifies the need for subdrainage by pointing out the magnitude of the investments of public funds and private capital on and beneath the surface of the earth, has been published by Toncan Culvert Manufacturers' Association, Republic Bldg., Cleveland, Ohio. The book shows the need for safeguarding the stability of earth material against failure through the use of numerous types of subdrainage systems which are described at length and illustrated with many photographs and drawings of Toncan drainage pipe in service.

A copy of this book may be obtained free by readers writing direct to the Association and mentioning this item.

THE NATIONAL CARBIDE V-G LIGHT

Gives you daylight conditions on night jobs.
Spreads a full, even beam of 8000 candlepower right where you need it.
Lights up the job for twelve hours on one 7-pound charge of National 14-ND Carbide and 7 gallons of water. Is easily handled by one man; has nothing to get out of order; no harm done if it tips over—just stand it up again, and it goes right on working. Weight 35 lbs. empty; 98 lbs. when full.

Write for catalogs on V-G Light, V-G Handy Light and Lantern

X-100

NATIONAL CARBIDE CORPORATION
LINCOLN BLDG. NEW YORK
(Opp. Grand Central)

END NEEDLESS LUBRICATION DELAYS WITH

POWER LUBRICATION ON THE JOB!

Alemite High Pressure Barrel Pump Model 6701-B
This amazingly efficient unit pumps grease directly from original 400-lb. drum; operates on 75 to 175 lbs. of air; develops up to 7000 lbs. pressure per sq. in. to service all high pressure fittings on tractors and other construction machinery.
Alemite Air-Operated Motor Oil Dispenser Model 6890
Dispenses oil directly from 54 gallon drum, for filling crank cases of tractors and trucks. Air header eliminates any pulsating caused by pump; delivers up to 5 gallons per minute. Available with motor which accurately measures oil dispensed!
Alemite Low Pressure Barrel Pump Model 6701-D
Delivers up to 15 lbs. lubricant per minute direct from 400-lb. drum, operating on air pressure of 75 to 175 lbs. Used on all gear housings, transmissions, final drives, etc. requiring large volume of lubricant. Develops 8 times air pressure used.

Avoid Expensive Shutdowns, Save Costly Minutes!

THE ALEMITE Portable Service Station, including the equipment described above, is saving thousands of dollars yearly for contractors who are now using it. Lubrication on the job is convenient, so it is not postponed. It's easy, so it's not neglected. Machines last longer, do better work with lower maintenance cost.

One break-down delay on an important job can easily cost more in penalties than the entire price of an Alemite Portable Service Station! The saving in lubrication time alone is an important item to any contractor with average equipment. And don't forget—the necessary air compressor permits inflation of tires on the job, too! Mail the coupon!

ALEMITE
A Division of Stewart-Warner Corporation
1850 Diversey Parkway, Chicago, Ill.
Stewart-Warner-Alemite Corporation of Canada, Ltd., Belleville, Ontario

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REG. U. S. PAT. OFF.
PORTABLE SERVICE STATIONS

ALEMITE — *A Division of Stewart-Warner Corp.*
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Please send complete information on Alemite Portable Service Stations for contractors.

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Address.....

City.....*State*.....

CONCRETE VIBRATORS
(Gas and Electric)
Concrete Surfacing Attachments

Master Vibrator Company, Dayton, Ohio
DISTRIBUTORS IN ALL PRINCIPAL CITIES

The New Browning Truck-Crane Under Test with a Full 15-Ton Load

Sectional Boom Built For 15-Ton Truck Crane

Booms up to 100 feet or more in length are being built for the new 15-ton truck crane recently brought out by The Browning Crane & Shovel Co., 16226 Waterloo Rd., N.E., Cleveland, Ohio. The sections which go to make up the boom are such as to give any desired length within 5-foot limits. The inserts are quickly put in or taken out by a 4-bolt joint, with the boom being so designed that no shearing stress comes on the bolts themselves.

The accompanying illustration shows the new Browning 15-ton truck crane under a test load of 15 tons with a 25-foot boom. This machine was actually tested with a 20-ton load without showing any signs of distress, according to the manufacturer. Additional informa- direct from the manufacturer by mention regarding this unit may be secured tioning CONTRACTORS AND ENGINEERS MONTHLY.

For State and County Testing Laboratories

Because so many state highway departments and counties which need a testing machine have been unable to buy one with the limited funds available, Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa., has developed a moderately-priced compact L-type hydraulic testing machine with a capacity of 20,000 to 60,000 pounds. Its overall height is 63½ inches, it occupies only 10 square feet of floor space, and has an approximate net weight of 2,000 pounds.

A moving piston in the machine supplies the necessary testing strain. The gear pump is a direct-connected type with a constant operating speed which, when the load is applied, produces no measurable pulsation. Testing speeds range from 0 to 2 inches per minute in stepless intervals, and the control is through a pilot hand wheel 8 inches in diameter.

The indicating gages are isolated from the machine proper by locating them on a separate instrument panel. The location of the cylinder itself in the base serves to lower the machine's center of gravity. Loading and unloading are handled by separate controls for each operation. The new machine is fully described and illustrated in Bulletin No. 20, which may be secured direct from the manufacturer by mentioning this magazine.

"Jobs as Monuments" is an excellent watchword for road contractors who are interested in our Annual Roadside Development Awards.

Kerosene Burners and Torches for Kettles

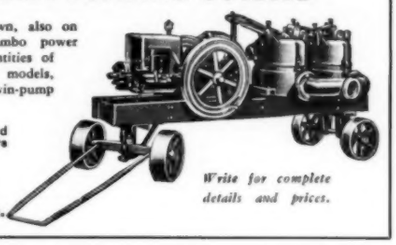
Contractors and highway departments are continuously modernizing wood-burning type kettles with kerosene burners and torches, as they eliminate smoke, sparks and ashes and give a clean, quick heat which melts tar, pitch, asphalt and other bituminous compounds in about half the time required by wood fires. Aeroil Burner Co., Inc., West New York, N. J., has recently issued a folder giving in detail the ten reasons why Aeroil burners save time, labor and expense, and including a complete price list of Aeroil heavy-duty single and double burner outfits and kerosene torch outfits.

Copies of this Bulletin 174 will be sent promptly to interested contractors and highway officials.

JUMBO DIAPHRAGM PUMPING OUTFITS

Mounted on four wheel truck as shown, also on pneumatic-tired, two-wheeled trailer. Jumbo power pumps are ideal for handling large quantities of dirty, gritty water. They are built in six models, 3" or 4" size, either single pump or twin-pump style.

Also manufacturers of air and water cooled engines, centrifugal pump units, concrete mixers and lighting plants.



NELSON BROTHERS COMPANY
Saginaw Mich.

Write for complete details and prices.

LOAD the CHEAPEST WAY—

The cheapest loading method is the one that holds the trucks for the shortest time. Truck time is the important factor in loading costs. Since 1919 Barber-Greene Loaders have continuously earned this reputation. Write for complete information, there is no obligation.

Standardized Material Handling Machines
BARBER GREENE
Aurora, Illinois

39-13

CHEVROLET'S TRUCK LINE is a Fleet in Itself

Choose from its 47 models, on nine wheelbases, the truck best suited to your needs

The wide margin by which Chevrolet leads all other makes of motor trucks in *sales* is also a direct measure of Chevrolet's leadership in *value*—for trucks are bought by business men who are intent, first of all, on getting the best return on their investment. More and more, they are finding that Chevrolet trucks *pay*—in economy, efficiency and durability. . . . This year, to a greater extent than ever before, Chevrolet's wide variety of trucks—47 models, nine wheelbases—makes the advantages of Chevrolet transportation available to the great majority of business and industrial uses. This variety of models, and their versatility that fits them to so wide a range of uses, also account for a large part of Chevrolet's predominant sales leadership.

CHECK—AND TRIPLE-CHECK—CHEVROLET TRUCKS FOR *Value Variety Versatility*

CHEVROLET MOTOR DIVISION, *General Motors Sales Corporation*, DETROIT, MICHIGAN
General Motors Instalment Plan—convenient, economical monthly payments. A General Motors Value.

DESIGNED FOR THE LOAD CHEVROLET POWERED FOR THE PULL

MASSIVE NEW SUPREMLINE TRUCK STYLING . . . COUPE-TYPE CABS . . . VASTLY IMPROVED VISIBILITY • FAMOUS VALVE-IN-HEAD TRUCK ENGINE • POWERFUL HYDRAULIC TRUCK BRAKES (Vacuum-Power Brake Equipment optional on Heavy Duty models at additional cost) • FULL-FLOATING REAR AXLE on Heavy Duty models only (2-Speed Axle optional on Heavy Duty models at additional cost)

Wyoming Depots Aid Road Work

Seven Modern Maintenance Stations Provide Better Facilities for Housing and Servicing Road Equipment

By R. J. TEMPLETON, District Engineer, Wyoming State Highway Department

✦ WYOMING, with its many Rocky Mountain ranges and great plains at high elevations, has long been famous for its wonders of nature. National parks, forests, historic shrines and countless beauty spots attract hundreds of thousands of visitors annually. Good well-maintained roads have made possible the development of a thriving tourist business which today ranks as one of the principal industries. Adequate and equitable service for all, whether residents, tourists or travelers passing through the state, has been the governing factor in the location of all arteries of the state highway system, which at present totals 3,773 miles. Eighty-two per cent of the roads have various types of oil surfaces, 9 per cent are gravel surfaced and 9 per cent earth graded. For the most part, traffic on the gravel-surfaced and earth-graded roads is exceptionally light.

Wyoming lies within the snow-belt section of the United States and high winds which usually accompany or follow the snowfalls, even the lighter ones, cause excessive drifting. Snow control and removal is therefore an important function of the maintenance division, as all state highways, with the exception of three mountain passes, are kept open and in good condition throughout the winter months. During all seasons of the year the maintenance force is continually engaged in routine, emergency or betterment work, requiring a varied line of dependable well-serviced equipment.

Division into Districts

For the purpose of administration and supervision, for both construction and maintenance, the state, which covers an area of 97,914 square miles, is divided into five districts, each with a District Engineer in charge and headquarters located at Cheyenne, Rock Springs, Casper, Basin and Sheridan. Each district has its Maintenance Foreman, under whose general supervision all maintenance work is carried on. To provide for efficient operations in all sections throughout the year, each district is divided into five or six unit areas. Usually the unit-area organization consists of about seven men with a Chief Maintainer (Crew Foreman) in charge. With few exceptions, unit-area headquarters are located in the larger towns, most frequently county seats.

The maximum number and classification of employees assigned to each district is described in the following table:

DISTRICT EMPLOYMENT SCHEDULE

CLASSIFICATION	MAXIMUM ALLOWANCE Dist. 1	Dist. 2	Dist. 3	Dist. 4	Dist. 5	Total
ADMINISTRATION						
District Engineer	1	1	1	1	1	5
ACCOUNTING DIVISION						
Timekeeper	1	1	1	1	1	5
Storekeeper	1	1	1	1	1	5
MAINTENANCE DIVISION						
Foreman	1	1	1	1	1	5
Chief Maintainer	6	6	5	5	5	27
Maintainer	18	15	10	15	15	73
Helper	24	21	15	20	20	100
Laborer	As Required					
EQUIPMENT REPAIR DIVISION						
Chief Mechanic	1	2	1	1	1	6
Mechanic	4	2	2	3	3	14
Helper	2	2	2	2	2	10
CONSTRUCTION DIVISION						
FIELD						
Project Engineer	As Required					
Instrument Man	As Required					
Engineer Helper	As Required					
Laborer	As Required					

The maximum allowance in each district is based on the size of the district (mileage), volume of traffic, etc.

New Depots Built

To improve the facilities for housing and servicing of equipment in the outlying unit areas, the State Highway Department embarked in 1937 on a standardized maintenance-depot construction program. At the present time, new modern depots at Sundance, Gillette, Cody, Lusk, Douglas, Rawlins and Lander, have been completed and occupied.

The State Highway Department Maintenance Depot at Gillette, Wyoming

The buildings are of one-story brick, concrete and steel construction. All are 46 feet 6 inches x 83 feet 6 inches in size, excepting the ones at Rawlins and Lander, which are 55 feet 6 inches x 103 feet 6 inches. Room dimensions of the two standard designs are:

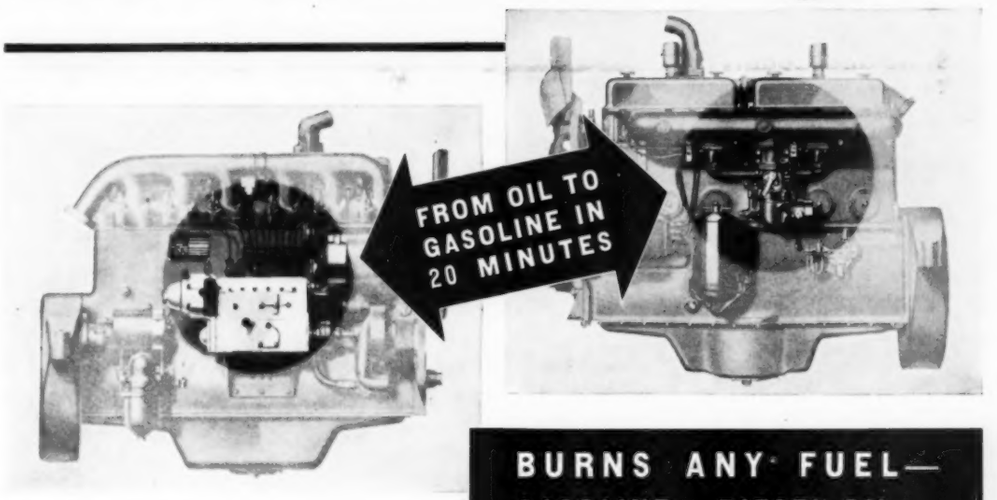
	Buildings 46'-6"x83'-6"	Buildings 55'-6"x103'-6"
Equipment Storage and Service Room	43'-0"x64'-0"	52'-0"x 81'-0"
Office	15'-9"x15'-9"	18'-4"x 19'-9"
Stock Room	15'-9"x15'-9"	18'-4"x 19'-9"
Lavatory, Shower and Toilet Room	11'-0"x12'-0"	12'-6"x 14'-0"
Boiler & Furnace Room	13'-0"x19'-0"	15'-6"x 21'-6"

The buildings have steel frames, with

(*Concluded on page 36*)

Concrete VIBRATORS
AND GRINDERS
Write for Circular on types, sizes and prices
White Mfg. Co.
ELKHART INDIANA

FROM THE WORLD-FAMOUS RESEARCH LABORATORIES COMES THE . . . . . **World's Most Flexible Engine**



By simply changing the fuel system, this new engine can burn gasoline, diesel oil, butane, natural or artificial gas. All the engines in the Waukesha Multi-Fuel Poly-Cycle series—221 cu. in. to 1200 cu. in.—are alike. Change of fuel involves no modification of internal parts—pistons, heads, manifolds, rods, crankshafts, camshafts, bearings—nothing of major importance need be changed.

BURNS ANY FUEL— GASOLINE...DIESEL OIL... BUTANE...NATURAL OR ARTIFICIAL GAS—WITHOUT INTERNAL CHANGES

WAUKESHA Multi-Fuel Poly-Cycle ENGINE

FROM THE OPERATOR'S STANDPOINT, this engine has the greatest possible flexibility. If he is burning gasoline, and moves to a locality where oil is most economical, buying and installing a fuel injection system makes it a Hesselman Oil Engine. On industrial or contractor's equipment which is always being moved, he has the choice of butane, natural gas, gasoline or fuel oil at a minimum of change-over expense and capital investment. A truck operator need never be stalled on the road with his oil engine. He carries a gasoline carburetor and, if the injection system fails, he comes in on gasoline. Injection system is removed for servicing and, *without lay-up*, he continues on gasoline until it is convenient to replace oil burning equipment. *Write for literature.*

WAUKESHA MOTOR COMPANY
WAUKESHA, WISCONSIN
NEW YORK . TULSA . LOS ANGELES

The Dickson Highway Safety Marker

Highway Markers for Day and Night Use

Dickson safety markers, available in Models A and B for darkness and Model C for daylight, are fabricated of a highly polished non-corrosive enduring metal equipped with a reflecting element hermetically sealed into the holder. The Model A, used for center of the road marking, shows its warning gleam in both directions and is visible for a thousand feet, yet it is small and sturdy enough so that its efficiency will not be impaired by abuse. The Model B marker has a one-way reflector and is used on the outside edge of roadways, on curves, dead-end streets, traffic circles, safety islands and other hazardous points. Both of these markers are installed by drilling a hole 1½ inches in diameter by 4 inches deep which is filled with concrete and the marker shank pushed in. According to the manufacturer, they will never move from their original position and are theft-proof. The Model C marker is a metal disc which is used extensively in combination with the Model A or B, thus assuring visibility for marking during a 24-hour period.

Dickson Highway Safety Marker, Inc., Orlando, Fla., claims that no description of Dickson markers is as convincing as an actual test and so offers to send, to accredited highway officials, a set of these markers for test purposes.

Crank-Adjusted Hitch For Spreader Boxes

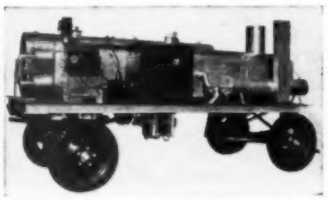
A mechanical refinement which is appreciated by operators and owners on Buckeye surface material spreaders, made by the Buckeye Traction Ditcher Co., Findlay, Ohio, is the crank control for the height of the coupling by which the spreader is attached to the truck. Since the height of truck frames from the road bed varies with different trucks, provision has always been made for raising or lowering the coupling to allow the spreader to ride level, but with this new crank control any change in height of the coupling can be made in a few seconds, or even while in operation.

The crank handles for controlling the height of the hitch, as well as its tilt, are located on the end of the spreader box. This leaves the operator in a safe position when a truck is being backed up to the spreader. The coupling is also released from this same operating position.

The fluted feed roll of the Buckeye spreader operates in direct relation to the speed of the truck, and a choice of speed ratios is afforded by interchangeable drive sprockets, making the delivery of the material accurate and uniform. This accuracy is maintained for either forward or backing-up spreading, because the feed roll is driven through a reversible transmission. Material from the size of sand to 1-inch stone and in any volume from a mere sprinkle to 60 pounds per square yard is possible with this spreader, according to the manufacturer. Full details may be secured from Buckeye direct by mentioning this item.

Bodies and Hoists Catalog

The Hercules Steel Products Co., Galion, Ohio, has available a new catalog containing list prices, complete construction details and many illustrations of its tire and Tool-Pack dump bodies, hydraulic hand-hoist dump bodies, center-lift and heavy-duty hoists and bodies and the split-shaft power take-off for driving any truck-mounted portable equipment. Also described and illustrated are the Cretemobile, a unit for applying cement pneumatically, and the Ditwiler power spreader. Copies of this Catalog No. 8 may be secured direct from the manufacturer.



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Every day the endorsement of GOHI Corrugated Pipe becomes more widespread and increasingly enthusiastic as the passing years roll up their accumulated evidence of the outstanding performance of GOHI . . . the longest-lived, low cost ferrous metal for drainage structures.

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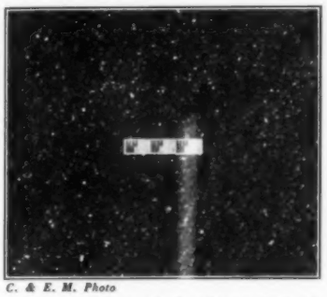

C. & E. M. Photo

Surface Texture of Coquina and Sand Road-Mix Before Sealing

Sand Stabilization On New Florida Road

(*Continued from page 13*)

sand onto the shoulder, back at least 4 feet from the roadway. The edges of the asphalt, which was at least 2 feet wider than the specified roadway, were cut away with square-edged spades and used to repair other roads. The finished roadway was from 8½ to 9 inches thick.

Work on South End

On the south end of this project the road was cored out to 4 inches below grade first and the shell hauled in and spread before any asphalt was applied. This work was done on about 7,200 feet of roadway and has stood up well under heavy traffic. This section was also included in the sealing of the entire job.

Matanzas Inlet Road

On another project along this same highway and just south of Matanzas Inlet, 2,000 feet of retread was applied over an old oyster-shell road which was used as a base. The road had been given some previous surface treatment with asphalt and sand. The retread treatment consisted of spreading about 3 to 3.5 inches of pit-run material consisting of 60 per cent coquina and 40 per cent sand, shooting it with 1.75 gallons of 45 to 60 base-penetration cut-back asphalt and mixing with two blades. In sections where there were pot holes the old base was scarified, but no deeper than necessary to roughen the old surface. At no place was the base cut through.

The entire mix on this road was bladed to one side of the traveled way and the surface shot with a tack coat of 0.15 gallon of the cut-back. Then the mix was bladed to the other side and the remaining half shot. Then the mix was spread over the entire surface and rolled. This job was finished about March 1, 1938, and most of the work was done when the air temperature was around 50 degrees F. The surface is now very hard and shows no marks under standing cars even in warm weather.

Personnel

The work described was done by Florida Road Department forces of the Jacksonville District Office, H. W. De Saussure, Division Engineer. In the field, J. J. Stringfellow was Project Engineer.

Diesel and Gasoline-Engine Compressors

The line of gasoline-engine-driven and full-diesel drive portable compressors, made by the Worthington Pump & Machinery Corp., Harrison, N. J., is described and illustrated in two new bulletins, No. H-850-B52 and H-850-B56, respectively, recently issued by this company. The gasoline-engine unit, which is available in five sizes of 60, 105, 160, 210 and 315 cubic feet, actual air delivered, with towabout, spring-trailer, truck, skid or power take-off mountings, assures a large volume of air at low cost for fuel and maintenance. The diesel-drive compressor, powered with a Hercules engine, is available in four sizes, 105, 160, 210 and 315 cubic feet, and all mountings. According to the manufacturer, this modern unit combines basic full-diesel advantages with portability. Copies of both or either of these two bulletins may be secured direct from the manufacturer by mentioning this item.

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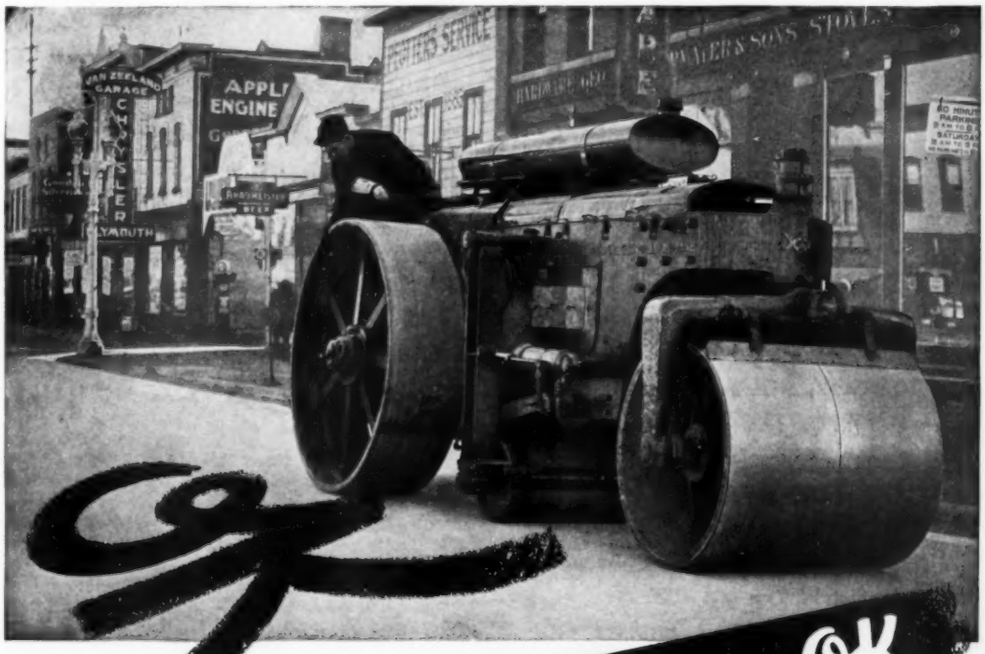

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By using a Roll-A-Plane on the *subgrade*, you secure a dense, well-made foundation . . . eliminating the voids where moisture collects to cause heaving or frost boils.

By Roll-A-Planing the *base course*, the action of the center roll makes it necessary for the workmen to spread the stone evenly so that the material is not only keyed and compacted; it has surface smoothness as well. When the base is Roll-A-Plane finished, there can be no high spots to break through the wearing course and start washboarding or raveling.

Finally, for "straight edge" smoothness, use the Roll-A-Plane on the *wearing course*. With a smooth base course beneath, you are assured of an equal density at a minimum of rolling time . . . for the action of the center roll makes cross rolling unnecessary.

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MINNEAPOLIS NEW YORK NEW ORLEANS KANSAS CITY, KAN.

Highway Studies Show Highway Traffic Needs

(*Continued from page 7*)

and the final divided four-lane design.

Experience with the divided roadway trunkline under conditions of increasing traffic volumes and speeds emphasizes the desirability of having a separating strip of adequate width. The protection it provides from headlight glare and conflict with vehicles thrown from the opposing lane by collisions as well as its service in aiding crossing and turning movements, appear amply to offset the added costs of right-of-way and construction.

Intersection Design

As traffic volumes grow, the need for separating the grades at major highway intersections or adopting other means for protecting traffic grows more pressing. Where the movements on both highways are very heavy and approximately equal, it is probable that the separation of the clover-leaf type is the most effective treatment. However, in locations with somewhat less traffic and particularly where more than two highways are involved in the intersection, well-designed traffic circles often accomplish the same purpose.

At intersections of divided-roadway trunklines with roads of minor importance, some use has been made of a modification of the traffic circle. In such cases, access across the center strip is by means of roads some distance on either side of the line of the cross road. This compels cross-road vehicles to take a roundabout path with ample opportunity for seeing and avoiding conflict with trunkline traffic.

Urban Conditions in Rural Areas

The extension of suburban development along trunklines radiating from urban centers has created problems of safety unlike those found in either purely urban or rural areas. The numerous intersections with semi-urban streets, the clustering of business places along the highway, the great increase in local vehicular and pedestrian traffic, all multiply the hazards in these locations.

Studies in areas within 15-mile radii of Michigan cities of 5,000 or more population show that, although these areas contain 38 per cent of all rural trunklines in the state, they account for 63 per cent of all fatal accidents on rural trunklines. Within a 3-mile radius, with only 8 per cent of rural mileage, 25 per cent of all fatal pedestrian accidents on rural trunklines occurred and within the 15-mile radius were concentrated 78 per cent of all intersection accidents.

The lessons to be drawn from this disclosure of the concentration of hazards in these expanding suburban districts may be briefly stated. Sidewalks for pedestrians are an inescapable part of highway construction in these areas. Adequate highway lighting must be given serious consideration. The greatest care must be exercised in designing and providing intersection facilities; where no separation or traffic circle can be provided there must be assurance of full sight distance. To accomplish this and to guard against dangerous development too close to the roadway, broad rights-of-way must be secured, broad enough to accommodate side service roads where they are necessary. Beyond these, intelligent speed zoning and strict enforcement must be relied on.

Conclusions

The phases of safety design discussed in this article are only details of the whole job of the traffic and highway engineer; in fact, they may well be said to be only the minor minutia which go to make up those details. But the highway and safety job is too complex to be comprehended in any single study, and it is only by isolating and solving the details that an acceptable highway system can be evolved.

Safety design is the refinement and perfecting of the means by which the fundamental requirements of highways are met. If streets and highways are made safer, they are also made more convenient for the motorist and more efficient in their service to the community. Traffic travels more smoothly over them with less delay. When, through the analysis and adjustment of details, we can eliminate the comparatives from that statement and say, "Traffic travels smoothly without friction or delay," the highway and traffic engineer will be warranted in feeling that he has his job well in hand.

From a paper presented before the American Public Works Association Annual Meeting in New York City, October, 1938.

Who Has the Biggest Job Of Highway Maintenance?

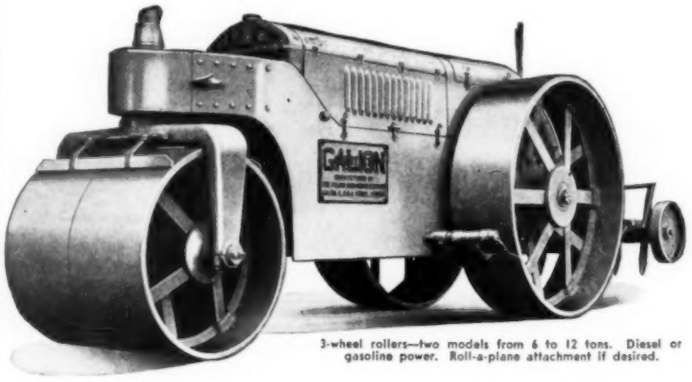
In the State of Washington this question is answered by the Director of Highways on page 104 of his report for 1938. The highways maintained by the State comprise 6,000 miles or 17 per cent of the streets, roads and highways in the state. Cities are responsible for 5,549 miles or 15.7 per cent, while the thirty-nine counties are responsible for the maintenance of 23,767 miles of roads, or 67.3 per cent of all of the regularly traveled ways within the state.

New Egypt-Palestine Road

The Government of Egypt has recently awarded the contract for the construction of the 140-mile road from Ismailia, Egypt, to Al Auja on the Palestine frontier to the Shell Company of Egypt, Cairo. This company has undertaken to complete the work in six months at a cost of about $700,000. The mix-in-place system of construction will be used and the road will be asphalted to a width of about 20 feet.

The U. S. Bureau of Foreign and Domestic Commerce reports that despite the fact that the Shell Company of Egypt was not the lowest bidder it was awarded the work because of the excellent reputation the company enjoys for the construction of roads.

Want information? Write the Editor.



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International roller—4 or 5 tons.

For any requirement in road building and maintenance, Galion has a roller to do the job exactly. The lightweight portable is now being used extensively for rolling black-top drives in residential construction work. Also ideal for rolling spacious lawns on estates, golf courses, clubs, etc.

Galion knows rollers . . . has been building them for years. We pass our engineering experience on to you. Let us know which type you need.

Also a complete line of motor patrols, pull graders, sanders, rooters and spreaders. Galion really goes into road building and maintenance . . . can help you do the job better.

Sheepsfoot rollers—in single, double, or tandem arrangement with water ballast rolls.

Portable rollers—with weight variable by adding water to ballast roll. Easily portable by attaching to truck.

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Why NOT an Etnyre!

The Post Assembly of Armorsteel Style 2A Roadguard and the Effect of the Initial Shock of a Car Striking the Face Plates

All-Steel Road Guard

A new style of all-steel road guard, particularly adapted to bridge approaches and very hazardous places requiring special protection has been announced by The Armorsteel Roadguard Co., Inc., 3030 Euclid Ave., Cleveland, Ohio, and is known as the 2A. The 2A is composed of steel posts of structural shapes with the standard Armorsteel H-section brackets, having two 10-inch lateral face plates attached to the offset brackets by a Y spring assembly.

The theory of and what actually happens to these Roadguards when resisting impact is that, first, the shock is partially absorbed by the spring joint which takes up about 2,500 pounds and permits the plates to deflect 9 inches before they are in tension. The plates then resist the blow and transmit it to the brackets which, if the force is great enough, will bend downward towards the post and then, if the force is not totally resisted, the balance of shock is taken by the steel post and the entire guard leans backward until the vehicle is brought to a stop. In one place where the 2A Armorsteel Roadguard resisted collision, its total movement from a straight line was 33 inches without rupture before it had absorbed all of the blow and had brought the car to a stop. The car was driven away at once without serious damage to the car or injury to its occupants.

The Style 2A is one of seven Armorsteel styles of varying gages and post spacing designed to meet specific requirements. Style D is designed for use on any kind of wooden post and it functions similarly to other Armorsteel designs.

The spring joint connection to the post eliminates the need of special end assembly, as the spring tension in alternate bays counteracts each other and is not accumulated at the end bays. This feature reduces the cost per linear foot of the road guard installation. Illustrated literature on this type of guard rail will be sent free on request by the manufacturer to those mentioning this descriptive item.

Four Wheel Drive Truck With Underbody Blade

A new model truck, designed primarily for underbody blade service for highway maintenance, yet which can serve as a truck and is suited for mounting a one-way or V-type plow, has been announced by The Four Wheel Drive Auto Co., Clintonville, Wis. The new Model HG has a 154-inch wheelbase and weighs 6,800 pounds with the cab. It may be equipped with an 8 or 10-foot body, is powered with a 6-cylinder 91-hp engine, and has a heavy-duty truck-type 5-speed selective sliding gear transmission, and full-floating front and rear driving axles.

The underbody blade is held so that it will cut alternately hard and soft spots in a road at slow or high speed without gouging or jumping. This is accomplished by a levelizer which rides behind the blade on each end, equalizing the pressure from the hydraulic rams on the blade to the uniform contour of the finished road. The blade is adjustable to carry material to either right or left and is set in an upright position to reduce wear on the cutting edge.

New Dealers Appointed

The Ransome Concrete Machinery Co., Dunellen, N. J., manufacturer of the Ransome line of concrete mixers and pavers, has recently announced the appointment of the Columbia Equipment Co., 81 S.E. Yamhill St., Portland, Ore., with branches at 87 Holgate St., Seattle, Wash.; N. 1402 Ash St., Spokane, Wash.; and Boise, Idaho, to handle its complete line of equipment in the states of Oregon, Washington and part of Idaho.

SAVE FOUR DIFFERENT WAYS WITH—

YAUN BETTER BUILT BASKET BUCKETS

1. You use a larger bucket due to the features eliminating weight where not needed.
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All water is eliminated which gives a dry fill. All suction in bucket eliminated, giving a 100% load.

Write for full profit story of our patented shell and Basket Buckets.

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New World's Record... ...Set at Coulee Dam

A WORLD'S RECORD which many construction men believe will stand unchallenged for a century, if not for all time, was set May 25 when crews of Consolidated Builders Inc. placed 20,684 c. y. of concrete in Coulee Dam. Average production was one yard of concrete every 4.18 seconds, or 861 c. y. every hour . . . . . .

Theoretical capacity of the mixing plant (operating on a 2-minute mix) had been placed at 18,432 c. y. By clipping seconds, and half-seconds, at every corner, this theoretical capacity actually was exceeded by 2,252 c. y.—or about one-ninth!

NO DELAYS—The story of the record pour is a story of superb engineering management, splendid esprit de corps and mechanical perfection, in which every man and every machine performed his or its allotted task perfectly. There were no mistakes, no mechanical failures and no delays. . . . . .

SYNCHRONIZATION—Involved in the operation are the world's largest cement-handling plant, aggregate plant, belt conveyors, concrete mixing plant and concrete placing equipment. Exactly synchronized and geared to maximum capacity, all of these gigantic units functioned flawlessly throughout the record-breaking day. ***From one mid-night to the next, the mixing plant never stopped a second, the eight 4-yd. mixers revolving and tilting continuously.*** . . . . . .

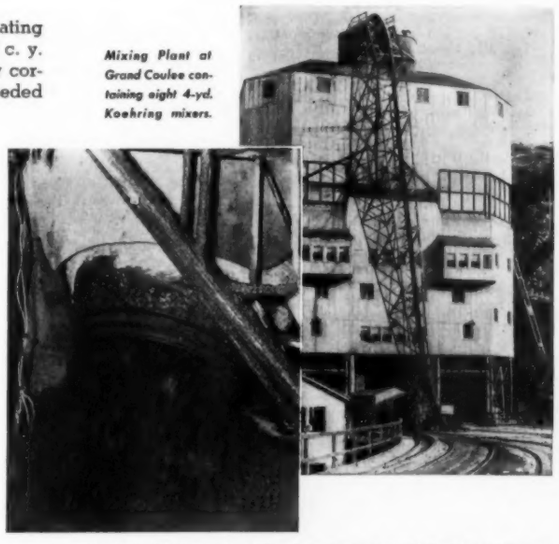
MIXING TIME REDUCED — Higher production of the day and swing shifts was aided by the fact that the Bureau of Reclamation allowed CBI to cut the mixing time five seconds in the morning and five more seconds in the afternoon and evening. Thus the graveyard shift used the normal two-minute mixing time, the day shift used 1 minute and 55 seconds; and the swing shift, 1 minute 50 seconds.

These successive reductions in mixing time were permitted because efficiency tests conducted by the Bureau's laboratories disclose that the resultant mix was in no way inferior to the regular 2-minute mix.

Efficiency tests are conducted periodically every day by Bureau engineers to determine if the cement is properly dispersed through the mix. If the mix is not within 10% uniform, the mixing time is increased. The 1 minute, 50 second mix ran well within the requirements of uniformity . . .

Excerpts from Pacific Builder and Engineer Issue of June 3, 1939.

CONGRATULATIONS to Consolidated Builders, Inc. for their Remarkable Achievement



Mixing Plant at Grand Coulee containing eight 4-yd. Koehring mixers.

Here's the sight that makes CBI officials smile. A 4-yd. Koehring mixer, such as this, dumps 24 batches an hour, sometimes 26 or 27. Theoretical capacity of the 8 4-yd. mixers, operating on a two-minute cycle, is 18,432 c.y. per day. They produced 20,684 c. y. on May 25 when mixing time was reduced. They operated for 24 consecutive hours without stopping once.

Koehring is indeed proud to have the privilege of being a part of the highly efficient organization for mixing and pouring concrete at this record breaking pace. We are proud Koehring mixers *did not fail* when called upon to do their share in establishing this record run. These mixers had poured more than 5,000,000 yards prior to this record run. Continuous service from Koehring equipment is that extra value you buy in all Koehring products.

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HEAVY-DUTY CONSTRUCTION EQUIPMENT

Avoid Legal Pitfalls

These brief abstracts of court decisions may aid you. Local ordinances or state laws may alter conditions in your community. If in doubt consult your own attorney.

Edited by A. L. H. STREET, Attorney-at-Law.

Contractor's Rights When Delayed

An opening for a possible lawsuit is left in any construction contract that fails to specify clearly just what will be the rights of the contractor on his being delayed in commencing or completing work, through the fault of the owner or other contractors. This is shown by the fact that hundreds of cases have come before the appellate courts of the country on the subject, and there must have been thousands of other cases that never got beyond the lower courts.

That it is perhaps safer, from the contractor's standpoint, to leave the contract utterly devoid of any provision defining his rights in this particular than to insert a clause that might be deemed to *limit* his rights would seem to be a logical conclusion under the generally recognized rule that the owner is liable to the contractor for damages sustained by the latter through his being delayed, *unless the contract otherwise provides.* (For an excellent and extensive annotation of that rule, see 115 American Law Reports, 66.)

Therefore, let us examine typical appellate court decisions to discover the trend of the judicial view on the effect of various contract provisions.

Provisions Extending Time

In many cases where contractors have claimed extra compensation on account of being delayed, the owner has pointed to a clause in the contract, specifying that the contractor should be allowed an extension of time for performance equal to the period of the delay. "By specifying this right to an extension, the parties have impliedly excluded any other right of the contractor," is an argument that has rung through full many a court-room.

There are numerous decisions to the effect that such a clause does not cut the contractor out of damages. For example, in State v. Feigel, 178 N. E. 435, the Indiana Appellate Court decided that the extension clause in a highway contract did not prevent the contractor from recovering damages sustained by him through the State's delay in furnishing the necessary right-of-way. And, in Robert Grace Contracting Co. v. Chesapeake & Ohio Northern Ry. Co., 281 Fed. 904, the United States Circuit Court of Appeals, Sixth Circuit, said concerning the railroad's delay in furnishing right-of-way to the contractor: "Nor will the extension of time which the engineer was to allow where there was a delay by the railway company, and which was in fact given, serve to defeat, necessarily, all recovery claimed. * * * It cannot be inferred that delay which threw the work over into the war period and enormously increased the cost of performance was intended to be neutralized merely by a corresponding extension of time."

On the other hand, there are decisions in which the specification of the right to an extension of time for performance has been adjudged to furnish the contractor's sole remedy. Such decisions have been rendered by the courts of California, New York, Pennsylvania, Utah and Washington.

It follows that it is desirable that the contract specify that the provision for extension of time shall not be understood as precluding the contractor from recovering compensation for losses resulting from fault of the owner or other contractors.

Clauses Barring Claims

A numerous class of decided cases involves contracts where there was coupled to the provision for extension of time a clause specifying that the contractor should not be entitled to damages on account of delay. These cases have usually involved the question whether the anti-damage clause gives absolute immunity without regard to the nature of the owner's fault or whether "circumstances alter cases."

That the courts are not disposed to stretch the plain wording of such provisions to protect a contractor against the consequences of a delay forced upon him is shown by what Mr. Justice Clark said on behalf of the United States Supreme Court in Wells Brothers Co. v. United States, 254 U.S. 83. There a contract to construct a Federal building in New Orleans contained this concise clause: "No claim shall be made or allowed to the contractor for any damages which may arise out of any delay caused by the United States." In effect, the highest court of the land said to contractors: "Either you ought to refuse to sign a contract with a clause like that in it or you ought to protect yourself by fixing a price for your work that will cover such damages as you may sustain through possible delay." What the court actually said was: "Men who take million-dollar contracts for government buildings are neither unsophisticated nor careless. Inexperience and inattention are more likely to be found in other parties to such contracts than the contractors, and *the presumption is obvious and strong that the men signing such a contract as we have here protected themselves against such delays as are here complained of by the higher price exacted for the work.*"

"During the Progress—"

That any stretching of a contract clause of this kind is apt to be done in favor of the owner appears from the decision of the Wisconsin Supreme Court in Nelson v. City of Eau Claire, 185 N. W. 168. There the job involved was removal of an old bridge for a city. The contract carried a clause exempting the city from liability for delays caused the contractor "during the *progress* of the work." Commencement of the work was delayed through the city's tardy removal of street railway tracks and gas mains from the bridge. The contractor claimed that the exempting clause did not bar a damage claim, because the delay did not occur during the progress of the work. But the Supreme Court said: "A delay at the inception of the work may be deemed a delay during the progress thereof, for according to plaintiff's allegations activities under the contract had already been begun—materials procured, men hired, and plaintiff in readiness to begin the removal of the old bridge. Under the provisions of the contract an extension of time was all plaintiff was entitled to for the delay, and that only upon giving the required notice of the cause." (The contract contained the customary clause requiring the contractor to notify the engineer of the cause of any delay in performance.)

Reasonableness of Delay

Whether a delay caused by the owner is reasonable or unreasonable cuts no figure, under a contract unqualifiedly exempting the owner, according to the decision reached in a New York case—Mack v. State, 202 N. Y. Supp. 344. However, in a later case, decided by a higher court, the Appellate Division of the New York Supreme Court said (American Bridge Co. v. State, 283 N. Y. Supp. 577): "Such clauses are usually considered inapplicable to delays so great or so unreasonable that they may fairly be deemed equivalent to an abandonment of the contract. * * * Whether a delay is so great as to be beyond the contemplation of the parties to the contract is a question of fact to be determined in the light of all the surrounding circumstances."

The last cited case shows that the immunity clause does not always stand in the way of a damage claim by the contractor. In that case the plaintiff contractor undertook to erect a bridge superstructure on piers to be constructed by another contractor with the State. The contract specified that no claim should be made against the State on account of delay in completing the piers. The State directed the plaintiff to fabricate the steel for the superstructure, in face of the fact that delay in the completion of the piers was probable. Deciding that the plaintiff could recover the cost of storing the fabricated materials and other expenses naturally incident to the delay forced upon it, the court said that the State's liability rested upon its act in ordering fabrication of the materials, rather than upon a theory of delay.

Another case in which the contractor won out in the courts was Wood v. City of Fort Wayne, 119 U. S. 312. There a contract to lay water-mains exempted the city from liability to the contractor for delays resulting from "delay in the delivery of pipes or other materials." Delay resulted through the city's delivery of misfit pipe connections. Upholding the contractor's right to damages, the United States Supreme Court said: "The defects were such as could not be detected until the castings were being put in place, and the claim is not for delay in their delivery, within the meaning of the clause referred to."

Personnel Changes

At a special meeting of the Board of Directors of the Industrial Brownhoist Corp., Bay City, Mich., held recently, Melvin Pattison resigned as President and Treasurer and was elected Chairman of the Board; Hoyt E. Hayes, Vice President, was elected President and Treasurer, and James B. Hayden, Assistant Sales Manager, was appointed Sales Manager.

WON'T QUIT
or cause time out

A Hayward Bucket keeps the job going ahead on scheduled time. It won't quit or cause time out.

The Hayward Company
32-36 Dey Street
New York, N.Y.

Hayward Buckets

PROFITABLE DITCHING

This is the smallest of the Barber-Greene Vertical Boom Ditchers, the Service Special. It is quickly hauled by trailer, making the smallest ditches machine jobs. There is also the Utility Special for digging close to obstructions, the Pipe Line Special for cross country and the big Standard. Write for the B-G Ditcher Catalog.

Standardized Material Handling Machines
BARBER GREENE
Aurora, Illinois

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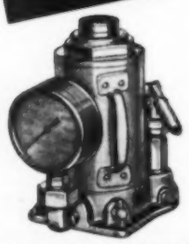
Economical and Portable
LOAD TESTING EQUIPMENT
FOR FIELD USE

75-ton Blackhawk Hydraulic Jack, equipped with gauge, testing sinking of piling under full load preparatory to erection of building.

BLACKHAWK Hydraulics Lift These Weights:
Hand Jacks — 1 to 75 tons.
Gauge Equipped Jacks — 7 to 75 tons.
Inverted Jacks — 7 to 50 tons.
Remotely Controlled Jacks — 10, 20 and 50 tons.



Model EA-11 with GAUGE mounted directly on jack
20-ton capacity, 4½" diameter gauge, calibrated "LBS. TOTAL LOAD" or "LBS. PER SQUARE INCH." Complete, only $53.20 net.

Use BLACKHAWK Hydraulic Jacks Equipped with GAUGES
—for economical "on the job testing" of concrete pipe, concrete beams, culverts, sinking piles to predetermined loads, checking weights of steel members, general press work and other required tests.

BLACKHAWK world-renowned Hydraulic Jacks equipped with GAUGES
—calibrated to read "pounds or tons total load" or "pounds or tons per square inch"—combine compactness, light weight, portability, precision-controlled power, dependability, accuracy, safety and economy in one unit for construction testing which has no equal. One man easily carries jack to the job, positions and operates it at full capacity.

Get double service from BLACKHAWK Hydraulic Jacks equipped with GAUGES
—use them also for the full range of regular lift, push, bend and spread jobs, which Blackhawk's construction permits, in addition to testing.

Save time, money and man-power with BLACKHAWK Hydraulic Jacks!
There's a size and type to meet every construction and engineering need — gauge-equipped, heavy-duty and remotely controlled. Blackhawk is *the only complete line of Hydraulic Jacks.*

Write for catalogs today.

A Product of BLACKHAWK MFG. CO.
Dept. J1879 MILWAUKEE, WIS.

BLACKHAWK
WORLD'S LARGEST MANUFACTURER OF HYDRAULIC JACKS

Provision for Arbitration In Construction Contracts

Lack of Coordination Has Left Heavy Construction Far Behind Other Industries In Use of Arbitration

By ARTHUR A. JOHNSON, President, The Arthur A. Johnson Corp.; Member, National Panel of Arbitrators, American Arbitration Association

✦ AN owner and contractor enter into a contract for an engineering project, the driving of piles for a building or the construction of a dam or some similar piece of engineering work. The agreement is entered into in good faith and the work begins. Before it has proceeded very far, however, trouble is encountered. It is discovered that the piles cannot be driven by the method specified in the contract without considerable extra expense to the contractor or that the subsoil is not of the type indicated by the boring sheets or test pits. Differences may develop into controversy, and controversy into delays and losses unless they are promptly adjusted. How, then, are these differences to be determined—by arbitrary decisions of the engineer or by arbitral methods?

If the contracting parties in an engineering project could be assured that an impartial, disinterested and inexpensive system of arbitration were immediately available in the event differences or controversies arose, many of the uncertainties and ambiguities which are usually present in an engineering operation would be removed, and the contractor could rely upon a fair and unbiased determination of his rights and obligations under the contract. This assurance is now given in a growing number of states in which it is possible for parties to written contracts to obtain security against litigation and delays with respect to such contracts, in advance of any dispute arising, by inserting an arbitration provision in contracts at the time they are drawn. And the fact that, under such clauses, the parties may take advantage of standardized arbitration machinery, national panels of qualified expert arbitrators, nominal arbitration fees determinable in advance, and enforceable decisions gives added assurance of protection.

Brief History of Arbitration

In the early days of arbitration in this country, it was practiced under English common law, under which an agreement to arbitrate was, and still is in the states which have not modernized their laws, revocable by either of the parties at any time before an award was made; the award was enforceable only by an action at law; the court was without power to stay an action while the arbitration was pending, and an agreement to arbitrate a future dispute was not legally valid. This situation created the greatest handicap to arbitration in the United States, for so long as parties could withdraw or evade the arbitration agreement and the award, few men were willing to use arbitration.

England corrected these defects by a modern arbitration statute in 1889 but it was not until 31 years later that there was enacted in this country the first modern arbitration law, that of New York State, in 1920.

This law was epoch-making in the history of arbitration. It made an agreement to arbitrate either an existing or a future dispute legally enforceable and brought the courts to the aid of arbitration, for they were empowered to stay an action at law until the arbitration had been held, to appoint arbitrators and to direct the arbitration to proceed in case of a default by a party. With the passage of New York's modern law, arbitration took a new lease on life, so to speak, and its practice has been steadily increasing ever since.

New Jersey was next in line, with a modern arbitration law in 1923; Oregon and Massachusetts in 1925, and the United States Arbitration Act became effective in 1926, as relating to interstate transactions and maritime matters. Since that time nine other states have passed similar laws: Arizona, California, Connecticut, Louisiana, New Hampshire, Ohio, Pennsylvania, Rhode Island and Wisconsin.

A number of other states, such as Illinois, Nevada, North Carolina, Utah and Wyoming, also have modern arbitration statutes, except that they differ from those of the above thirteen states in this important respect: an agreement to arbitrate a future dispute is not legally enforceable, and questions of law arising in the course of a proceeding may be referred to the courts at the option of either party.

Differences in Arbitration Laws

Arbitration clauses agreeing to arbitrate future disputes are valid, irrevocable and enforceable under the arbitration laws of Arizona, California, Connecticut, Louisiana, New Hampshire, New Jersey, New York, Massachusetts, Oregon, Ohio, Pennsylvania, Rhode Island and Wisconsin.

Agreements to arbitrate specific, existing disputes are generally valid, irrevocable and enforceable under the arbitration laws of the above named states and also of Colorado, Illinois, Iowa, Kentucky, Michigan, Minnesota, Nebraska, Nevada, North Carolina, Utah, Washington and Wyoming. In certain other states, such as Arkansas, Florida, Idaho, Indiana, Kansas, Montana, Tennessee, Texas, Vermont, Virginia and

(Concluded on page 37)

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Either Steel or Aluminum
For Checking Concrete Surface
Two useable edges:—one sharp-cornered and squared for scraping; the other rounded for line-point straightedging.
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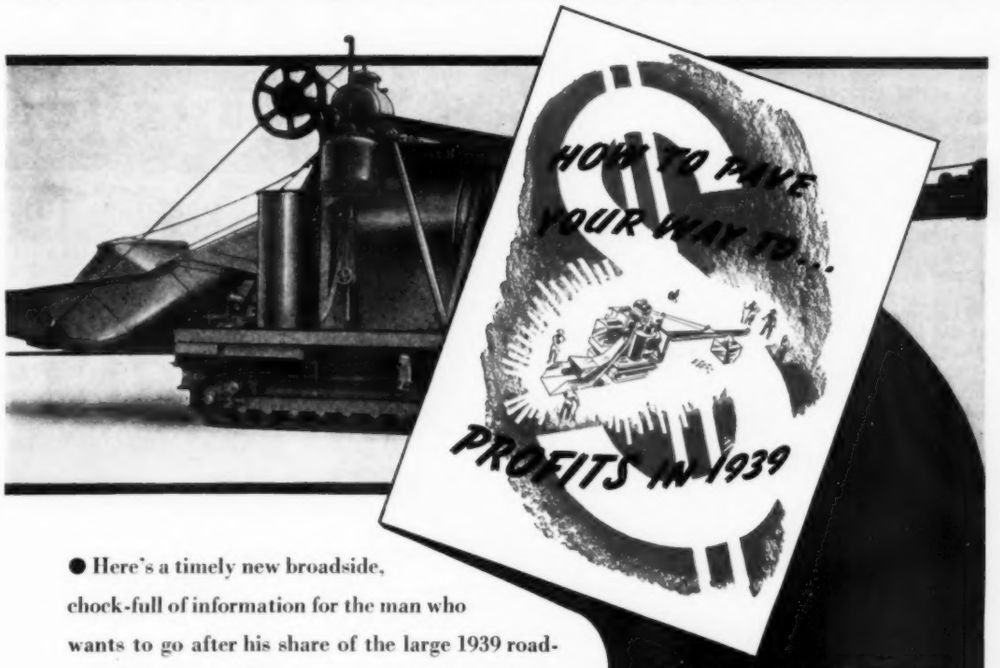
HOW TO PAVE YOUR WAY TO PROFITS IN 1939!
With the REX 27-E PAVEMASTER



● Here's a timely new broadside, chock-full of information for the man who wants to go after his share of the large 1939 road-building program! It's the complete story of what's new and proved in modern Rex 27-E Pavemaster design. It shows you in detail how the famous Rex Mechanical Man operates to give you more batches in place every hour, every day—more miles behind you every week—more paving profits from every job! Make up your mind to make more paving dollars in 1939 and send for this broadside as the first step in that direction! Use the handy coupon.

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Please send me my copy of "How to Pave Your Way to Profits in 1939."
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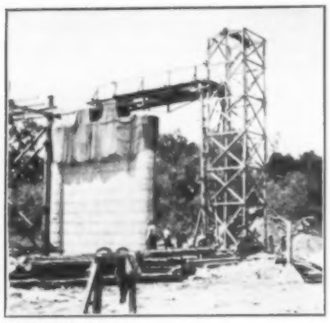

C. & E. M. Photo
Moving the Concreting Gantry from Pier 4, Shown Completed

Concreting Methods For Carolina Bridge

(*Continued from page 2*)

hammer was handled with a Universal 30 having a 30-foot boom and when excavation started it swung a ⅝-yard Blaw-Knox material-handling clamshell for removing the loose material in the holes.

No. 4 Pier

No. 4 pier has the same dimensions for the footings as No. 5. The circular columns are 5 feet 9⅜ inches in diameter at the base and battered uniformly ⅜ inch in 12 inches. The web wall carried from 3.5 feet below ground elevation up to the cap is 18 inches thick and the whole carries a cap 24 feet 4 inches long rounded at the ends to match the columns and with a 3-inch chamfer all around. The cap is 1 foot 6 inches high and 4 feet 1 inch wide.

Form Work

To support the forms for the piers above the footings the contractor used three piles driven on the center line of the bridge and centered about the footings of the piers. These and four other piles around the ring of sheeting were later extended by splicing to support the forms for the decking. The web wall and the columns were poured in 10-foot lifts in forms of 1¼-inch x 6-inch tongue and groove lumber lined with Masonite 3/16-inch plywood. The panels 12 feet 6 inches in height were used repeatedly on the web wall and the various lifts of the column forms were used on the other columns at the same heights. The studs were 2 x 6's and double 2 x 6's were used for wales. A ⅝-inch rod and sleeve in the concrete were used with the Universal form clamps on the inside for spacing the wall forms.

A roomy carpenter's shed was provided for the making of the forms and it was equipped with a large saw table, serving either the circular saw or the band saw, both driven through clutches by the same gas engine. The circular forms for the bases of the columns were assembled on the ground at another location and with scaffolding around to permit easy work on the upper sections. The forms were moved complete to the excavation.

Concreting

The center of the concreting was a high gantry moved ahead on a pair of single rails laid on heavy piles spanning the excavation. On one side of the gantry was a tower about 7 feet square cantilevered from the structure beyond the rail, securely blocked when the tower was in use, and then left free when the tower was moved ahead by man power. The gantry was built up of posts or columns consisting of 6 x 8's next to the forms and 4 x 4's on the outside. The tower was braced with 2 x 4's on the sides. The guides for the material elevator, which was 6 feet square, consisted of 4 x 4's or a pair of 2 x 4's. The elevator itself was built sturdily of 4 x 8's and heavy planking.

The bridge across the top of the gantry, supported by the tower on one end and by a duplicate of the inside columns and bracing on the other side, consisted of 6 x 8 stringers and 4 x 6 floor beams planked with 3 x 10's. A truss system on either side of the platform used ¾-inch rods with turnbuckles. The entire gantry was also braced with long diagonals of ¾-inch rods from top to bottom both ways. A pair of holes 3 feet square was cut in the platform for the pouring of the columns.

The entire gantry was carried on four 10-inch flanged wheels on either rail. The wheels were mounted in a 10 x 10-inch sill. During use, the tower as well as the far side of the gantry was guyed by long steel cables fore and aft.

The concrete plant consisted of a Jaeger 2-bag mixer set up about 20 feet from the material elevator with stockpiles of gravel and sand nearby. All aggregates were weighed in wheelbarrows on a standard Fairbanks beam scales. After a 1½-minute mix the concrete was dumped into Jaeger concrete buggies with 4-foot rubber-tired wheels and the buggy sent up in the elevator operated by the hoist on the mixer. The concrete was poured through a 3-foot square hopper and thence into elephant trunk chutes. Two Mall vibrators were used. Water for the mixer and for curing was furnished by a Domestic triplex road pump powered with a Waukesha engine.

The concreting crew was made up of the following: Two men wheeling sand and two wheeling stone and weighing their own barrows; one mixer man; one cement man; two men wheeling each buggy; two men at the top on the buggies; two men at the pouring hoppers; two vibrator men.

For curing, after the forms had been stripped in 24 hours, the contractor covered the tops of all piers with burlap and set up spray pipes to sprinkle the burlap for seven days.

The Approach Fills

The approach fills at the ends of the bridge structure were large and were placed by end-dumping with a fleet of motor trucks and spreading with a Caterpillar Thirty-Five diesel and Euclid hydraulic bulldozer. The fill was spread in uniform layers of about 6 to 8 inches thick and was not rolled but was thoroughly compacted by the constant hauling over it by the trucks and the tractor.

Personnel

The Rocky River Bridge was built by the Boyle Road & Bridge Co. of Sumter, S. C., which received the contract on its low bid of $45,053.24. For the contractor the work was in charge of J. M. Barnwell, Superintendent, and J. S. Wood, Assistant Superintendent, under the general direction of T. R. Furches, General Superintendent in charge of the group of road and bridge contracts which the contractor completed in this section. For the South Carolina State Highway Department the work was in charge of T. F. Anderson, Resident Engineer for the approach fills, C. T. Julien, Resident Engineer, and J. R. Webb, Assistant, on the bridge contract.

Ornitz Placed in Charge Of CMC West Coast Office

Construction Machinery Co., Waterloo, Iowa, has announced the appointment of Edward M. Ornitz of Los Angeles to take charge of its West Coast office. Mr. Ornitz has had a wide experience in cooperation between distributor and contractor and has been identified with Coast equipment circles since 1916. His headquarters will be at 206 South Spring St., Los Angeles.

Winter is Never Over For Highway Engineers

The winter season left us several months ago, spring has come and gone and now summer is immediately ahead of us, but for a state highway department winter never really ends. When one winter comes to a welcome close, the department starts preparing for another. A recent bulletin from the Minnesota Highway Department states that orders have gone out already to all maintenance engineers to take inventory of their snow fence, itemize requirements for additional fence, and if possible to list any fence that can be spared from one district for use in another. Likewise, the department shops throughout the summer months work to repair and put in shape all winter maintenance equipment such as snow plows, blades, and sand spreaders, preparing for climatic severities such as only a few other state highway departments have to combat.

PILE HAMMERS and EXTRACTORS
HOISTS–DERRICKS WHIRLERS
•
Special Equipment
Movable Bridge Machinery
•
Write for descriptive catalogs.
McKIERNAN-TERRY CORP.
19 Park Row, New York
Distributors in Principal Cities

P&H TRENCHERS

BRING BUSINESS YOUR WAY!
Get your share of the profitable sewer jobs with this P&H Trencher, built to dig more feet per day at a lower cost per foot . . . P&H Trenchers are built in two standard sizes: the Model 10-30, as illustrated, cuts a trench up to 13 feet deep and from 15" to 36" wide; the Model 15-36 cuts a trench 20 feet deep and from 22" to 42" wide . . . P&H Trenchers are available for rent or for sale, at attractive prices. Don't wait! Write today for full details. Harnischfeger Corporation, 4419 West National Avenue, Milwaukee, Wisconsin.
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EXCAVATORS • ELECTRIC CRANES • ARC WELDERS P&H HOISTS • WELDING ELECTRODES • MOTORS

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And DEPENDABLE
DUAL or TANDEM DRIVE
The NEW HUBER GRADER full Hydraulic control • Permits one man to handle all work • Write to-day for bulletin.
THE HUBER MFG. COMPANY, MARION, OHIO
Buy a HUBER
ROLLERS GRADERS • INDUSTRIAL TRACTORS • HIGHWAY MOWERS

Anti-Corrosion Compound For Lap-Welded Metal

A new compound has been developed by General Electric Co., Schenectady, N.Y., to meet the needs of welding fabricators for a material which, when applied to metal to be lap welded, will prevent corrosion at the point where the plates overlap. This new material, Glyptal 1294 Gray, is a pigmented version of Glyptal 1294 Clear and, like the latter, prevents the adhesion of weld spatter when applied to parts before welding. On lap welds it prevents corrosion at the overlap and at the same time it serves as a good base for painting.

Glyptal Gray can be sprayed or brushed and the work can be left exposed to the atmosphere until fabrication is complete with the assurance that edges of the parts will not need cleaning before the final welding operation.

Motor Grader Catalog

The Adams No. 50 motor grader, powered with an International 66½-hp gasoline engine, and No. 51, powered with an International 62½-hp diesel engine, have a widely diversified application. In a catalog, recently issued by J. D. Adams Co., Indianapolis, Ind., complete construction details are given as well as the engine and grader specifications for both units, and there are many interesting photographs showing their wide range of usefulness during summer construction, fall maintenance and, with snow plows and wings, for keeping highways open during the winter. Copies of this catalog, Form 3816, may be secured by those interested direct from the manufacturer, or from this magazine.

Bolt and Screw Anchors

The Rawlplug Co., Inc., 98 Lafayette St., New York City, has just issued a 38-page handbook, "A Better Anchorage for Bolts and Screws," which is profusely illustrated, has many tables and charts and other valuable data, as well as descriptions of many applications of Rawlplugs for anchoring screws and bolts in concrete and masonry walls and floors. A copy of this Catalog 39 will be sent to anyone writing to The Rawlplug Co., Inc., and mentioning this paper.

Above—Chas. H. Spiekerman's fleet at Saginaw, Michigan.

Below—Mr. Spiekerman (left) examining part of the portable testing equipment used by M. J. Volz, the Standard Automotive Engineer at Saginaw. W. N. Taylor, Standard Oil representative, (right) points to exhaust gas analyzer.

THIS SAGINAW FLEET NOW USES 25% LESS OIL

There is a wide variety of equipment in the Charles H. Spiekerman fleet shown above. When a Standard Automotive Engineer finished checking this fleet, practically every unit from the semi-trailer to salesmen's cars showed some improvement. The average saving was about 24% in gasoline and 25% in motor oil.

On the semi-trailer Mr. Spiekerman finds that he now makes his Detroit run—about 220 miles round trip—without adding any oil. Before the Engineer's checkup, and before changing to Iso-Vis Motor Oil, he added a quart or more of oil each trip. And a more expensive oil than Iso-Vis at that.

P. B. Rickcords, Automotive Engineer, Peoria, Ill., checks fuel pump pressure.

SAVES 19% FOR EAST PEORIA SAND AND GRAVEL CO.

That 19% saving wasn't on gasoline alone but on all operating costs for a dragline, a gasoline locomotive and a number of large, 10-wheel dump trucks. But that was only part of the saving that a Standard Automotive Engineer was able to help this fleet owner make.

In addition, his thorough checkup of the fleet pointed out spots where trouble might occur. Repairs could be made before a complete failure of these parts tied up the equipment. This resulted in more reliable operations—less time in the shop—more power on the job. That meant a lot to this fleet where trucks operated 24 hours a day.

Let a Standard Automotive Engineer show you how he works and where these economies can be made in your fleet. If you are in the 13 Midwestern states served by these Engineers call your Standard Oil (Indiana) office or write 910 South Michigan Avenue, Chicago, Illinois.

FIRST IN SERVICE FOR FIFTY YEARS STANDARD OIL (Ind.)

VALVE TROUBLE ENTIRELY ELIMINATED FOR TRUCK FLEET

On finding that his shop costs have been reduced approximately 15% through the help of a Standard Automotive Engineer, a Missouri truck line operator writes:

Gentlemen:

"In checking into my operation, I find a great deal of good has been done by your engineer, who made a survey of our fleet about ten months ago. He started a campaign to keep oil filters and air cleaners in good condition.

"We were having considerable trouble with sticking valves and I believe that his work has completely eliminated this trouble.

"I wish to take this opportunity to thank the Standard Oil Company for the wonderful cooperation in this work and in trying to assist us in getting from your products the results and service for which they were purchased."

F. A. Barnes (left), Automotive Engineer, Quincy, Ill., explaining importance of air cleaner maintenance to shop foreman.

STANDARD OIL COMPANY (INDIANA)

AUTOMOTIVE ENGINEERING SERVICE LOWERS MILEAGE COSTS

Hansen Dam

(*Continued from page 10*)

the Dragveyor outfit about 10,000 yards.

The Dragveyor is served by a 100-B Bucyrus-Erie electric crane with a 90-foot boom and an 8-yard Sauerman Crescent scraper. The Sauerman bucket pulls the earth up onto the lower end of the belt conveyor against a wood barricade so that it may be moved quickly up the incline and poured onto the truck when one is spotted. The movement of the belt is controlled at the top where the operator sits above the trucks and can see how they are spotted. A signal system consisting of a series of letters that light up indicates to the truck operator what he is to do. He drives his truck up to the Dragveyor and spots his cab by an arrow swinging from the end of the loading unit. The Dragveyor operator at once starts the belt in motion and the full belt pours the material into the 16-yard body. The first spotting is for the loading of the front of the truck. As soon as it is piled high the Dragveyor lights up the "F" and the truck moves forward, if too much the "R" shows and he backs a bit. When he has gone about far enough the "S" shows as a signal to stop and when the load is completed he is given the "G" which in the lingo of the truck operator means not "go" but "highball, Big Boy."

The 60-inch belt conveyor is housed in a heavy sheet-metal tunnel built of 5/16-inch sheets with double plates on the bottom for sliding. The belt is driven by a 75-hp Westinghouse motor controlled by a street-car controller at the top of the belt. The machine has to be moved about 14 feet at a time and this occurs about twice an hour. Moving is handled by pulling forward with the dragline and having the nearest truck catch onto the outer end to prevent the Dragveyor from swinging. When it comes time to move the machine back to the other end of the pit five Caterpillar tractors are hitched to it and away they go.

The pit from which the Dragveyor unit is moving dirt is 18 feet deep and the scraper works over an arc of about 60 feet. At the rate the machine moves dirt it has to be moved forward itself about 85 feet per shift.

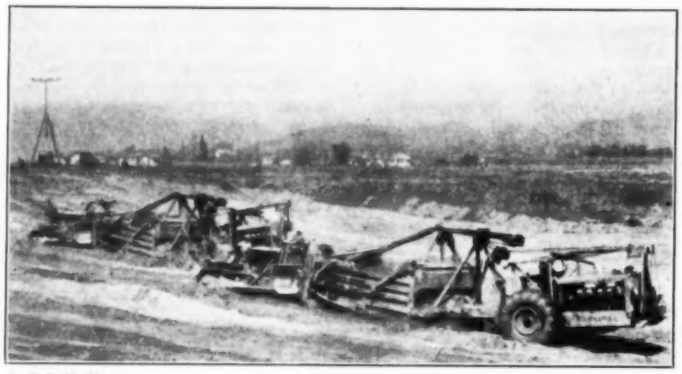
Spreading and Rolling Dirt

The material, both impervious and pervious, is spread in 6-inch layers either by direct spreading as with the Tournapulls and the single 12-yard Carryall which is used to pick up loose material in the pit and thereby give a firmer traction for the bigger machines, or by end-dumping and spreading with bulldozers in the case of the trucks. In Zone 4 the sand and gravel is washed in by jetting, pooling, or with a high pressure hose. A total of five sheepsfoot rollers of various makes are used for compacting the material in Zone 2 which includes the cut-off trench and the blanket under Zones 3 and 4. For pulling one gang of twelve-section sheepsfoot rollers the contractor removed the 90-hp diesel engine from one of his tractors and installed a 160-hp unit of the same manufacture.

A fleet of three No. 12 Auto Patrols maintains the roads and is used on top of the dam to maintain the slope of the material so that rains will drain perfectly and not pool, causing soft spots in the core. The average density for the material rolled into the dam has been 126 pounds per cubic foot for the impervious material and 132 pounds per cubic foot for the pervious material.

Other Equipment and Its Work

Before the big embankment could be started, the contractor was required to strip the surface of the ground of standing vegetation to a depth of 12 inches. This was done by plowing with gang plows and large disk plows and then rolling the material to a firm foundation.



C. & E. M. Photo

A Pair of Tournapulls Loading with the Aid of Pushers

As water is now known to be the means by which the maximum density of a volume of earth may be attained, the "water wagon" has assumed considerable importance on all construction involving earth fills. The contractor on Hansen Dam uses two Sterling trucks with 3,000-gallon tanks and driven by Cummins diesel engines. A 5-inch pump is geared to the drive shaft so that the delivery of the water is proportional to the speed of the truck.

In order that the job may run as smoothly at night as during the day, the borrow pits, as well as all other parts of the work, are illuminated to high intensity by means of 500 and 1,000-watt electric lights mounted on high poles. Some of the poles carry as many as six lights and others even eight, while in the less congested areas the poles may carry only one or two lights.

The Atkinson Company maintains two welding trucks ready for service at any time. They are both electric welders, one a Lincoln welder with a Hercules

(*Concluded on next page*)

Portable
MOTORIZED
WHEELED
ROLLERS

Compaction Equal to Most 5 Ton Rollers

HERE is the Littleford *Portable* Model 150 Motorized Wheeled Roller, the Roller that trails behind any maintenance truck at any speed, yet gives as much compaction as many 5 ton Rollers.

Designed for patch and restoration work, this Model 150 saves expensive handling costs—it's easy to move from place to place. No extra equipment or attachments are necessary.

It is a simple job to convert the Model 150 from the trailing to rolling position. Any operator of average weight can convert it to any position in 60 seconds. The "Tongue Up-and-Over" principle makes it easy.

This Model 150 is the *modern* roller—it's different and more efficient. Write for further details.

The Littleford Models "B" and "C" Wheeled Rollers are truck powered and have the same trailing and "Tongue Up-and-Over" principle as the Model 150. For highway maintenance work, these rollers have no equal. Write for details.

LB LITTLEFORD

LITTLEFORD BROS.
485 E. Pearl St. Cincinnati, Ohio

RS 1 Heil Hydraulic Dig-N-Carry Scraper in the service of Knox County, Ohio.

You get more yardage per day—and lower costs on finish grading, too

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Heil *Dig-N-Carry* Hydraulic Scrapers

—finger-tip hydraulic control of every operation in • digging • hauling • dumping • spreading

. . . means fast, smooth, accurate cutting and spreading. You know you can safely figure low enough to get the good jobs. You make more money, and do clean, on-time work that makes you a "preferred" bidder. Heil engineering assures you of dependable service and low maintenance expense year after year. Write today for free information.

MILWAUKEE, WISCONSIN THE HEIL CO. HILLSIDE, NEW JERSEY

Hansen Dam

(Continued from preceding page)

diesel engine and the other a General Electric welder with a Hercules gas engine.

The Grease Truck

One of the most important units on the entire job is the grease truck which is busy most of the time with the vast amount of equipment moving constantly over the large area covered by the operations. The truck is a 3-ton International flat-bed truck carrying a Covic diesel engine to furnish power for an air compressor for tires and for the grease guns and for a generator for lights. A fairly large air tank is included in the equipment. In spite of the reputed fine weather of Southern California the contractor is ready for anything and under the track and roller grease barrels are electric hot plates to keep the grease in an easily usable condition. The truck carries fifteen drums of various kinds of high grade lubricants for the specialized requirements of the various pieces of equipment in operation on the job.

The trucks, Tournapulls and other automotive equipment are pulled off one at a time once during each shift and fully lubricated with the proper grade of lubricant.

The Right-of-Way Problem

All of the right-of-way for Hansen Dam had to be secured by the Los Angeles County Flood Control District before work could be started. This involved the acquisition of over $1,500,000 worth of land, including 1,300 acres of rock and gravel pits in commercial operation, citrus groves, and several small developments, as well as arrangements for the moving of many utilities. A 30-inch water main of the Los Angeles city supply, several small distribution lines of the Los Angeles municipal power department, a 16-inch natural gas line and its distribution system, two main highways and several trunk telephone lines had to be moved and a 200,000-volt transmission line of the Southern California Edison Company will be moved in the near future.

The contractor made arrangements to tap one of the city power lines for all the electric power needed for lighting the job and for the operation of the dragline and Dragveyor.

Personnel

Guy F. Atkinson Company of San Francisco, Calif., was awarded the contract for the construction of the earth-fill dam and spillway structures on its low bid of $5,688,419.60. The company has employed about 750 men on an average but as soon as the concreting of the spillway section and the rock facing get under way the number will rise to about 1,200 men. For the contractor, George H. Atkinson is Job Manager, A. E. Holt is General Superintendent, D. E. Root is Chief Engineer, E. M. Jennett, Assistant Manager, J. A. Kier, Assistant Superintendent, J. J. Nunn, Equipment Engineer, J. H. Waugh, Office Manager, and C. E. Ferguson, Master Mechanic. For the Los Angeles County Flood Control District, U. S. E. D., Major Theodore Wyman, Jr., is District Engineer, Capt. G. K. Withers, Operations Officer, Capt. N. A. Matthias, Chief of Engineering, George F. Carey, Area Engineer, and A. H. Steiner, Resident Engineer.

C. & E. M. Photos

Tournapull Accessories for the Pusher and Puller Tractors During Loading. Left, the Hook on the Front. Above, a Pusher in Action

Link-Belt Co. News

Link-Belt Co., Chicago, Ill., and Philadelphia, Pa., has announced that the Twin Disc Clutch Co., Racine, Wis., has appointed Link-Belt its distributor for Twin Disc friction clutches and clutch couplings in all industrial fields. Complete data on these clutches, together with dimensions, horsepowers, list prices, etc., are found in Link-Belt's new power transmission book No. 1600, a copy of which will be sent on request.

Link-Belt has announced that Hayes Parsons, 511 East 47th St., Seattle, Wash., district representative for the sale of Speeder Machinery Corp.'s crawler, truck and tractor-mounted shovels, draglines, and cranes from ⅜ to 1-yard capacity, will in the future also represent the Shovel Division of Link-Belt Co., thus adding the 1¼ to 2½-yard capacity line of Link-Belt crawler-mounted, hydraulic-power-controlled Speed-o-Matic machines to its sales group. Robert M. Taylor, Jr., 1177 Howard St., San Francisco, Calif., formerly associated with P & H, will assist Mr. Parsons in handling the Link-Belt and Speeder lines in the states of California, Nevada and Arizona.

The appointment of The Klinger-Dills Co., 116-120 N. Jefferson St., Dayton, Ohio, and the Kenny Machinery & Tractor Co., 2136 Jefferson St., Kansas City, Mo., as agents for Link-Belt Speed-o-Matic crawler-mounted shovels-draglines-cranes, as well as the ⅜ to 1-yard Speeder line of crawler and truck-mounted machines, has also been announced.

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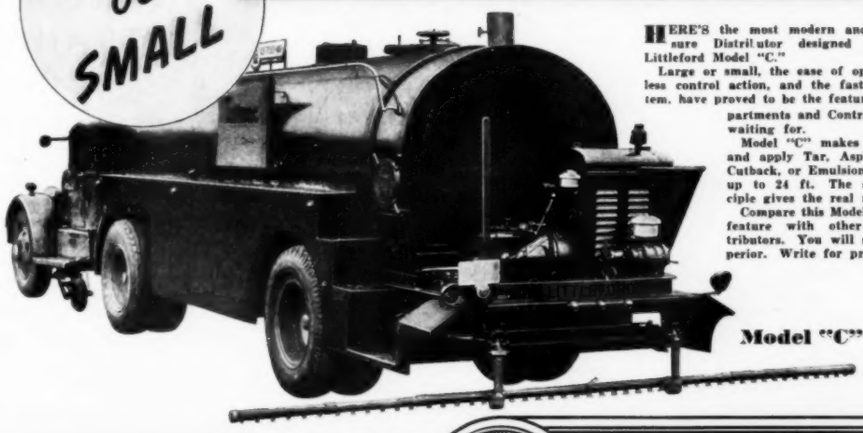

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Large or small, the ease of operation, gadgetless control action, and the fastest heating system, have proved to be the features Highway Departments and Contractors have been waiting for.

Model "C" makes it easy to heat and apply Tar, Asphalt, Road Oils, Cutback, or Emulsions, on spray bars up to 24 ft. The suck back principle gives the real no-drip action.

Compare this Model "C" feature for feature with other Pressure Distributors. You will see why it's superior. Write for prices and details.

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It must "LOAD" and "unload" easily. Be strong but light to "HAUL" with comparative ease—and be capable of reliable control and quick stopping in the face of emergencies.

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From .....
(Old address)

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To .....
(New address)

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Name .....

Balanced Grading Outfit Works in Top Soil and Rock

Shovels Load to Hauling Units and Scrapers Make Short Hauls on Ryan Bros. Contract in Wisconsin

(*Photo on page* 1)

✦ RYAN BROS. of De Pere, Wisconsin, was the low bidder on a tough grading job located in the hills on the east side of the Mississippi River in southwestern Wisconsin on the Bridgeport-Mount Hope section of the Dodgeville-Prairie du Chien Road, U. S. No. 18. The soil on this 5.618-mile job is rich, black top soil, washed down from the hills, with plenty of loose rock. Work started on June 15, 1938, and was completed on November 25, within the contract limit of 170 calendar days.

The job was well-designed, with the cuts and fills about equally divided. The largest cut was 40 feet high on the side of a hill, from which about 45,000 cubic yards was removed. Other deep cuts averaged about 30,000 yards and the deepest fill contained about 45,000 yards. About 38,000 yards of solid rock was removed from the cut, presenting many difficulties because of its peculiar formation in layers about 3 feet thick. A total of 24,000 yards of solid rock was removed from one 24-foot cut.

The contractor used two power shovels with separate hauling fleets for each, and tractors and scrapers on the short hauls in good dirt. A 1¾-yard Manitowoc shovel loaded to four Allis-Chalmers Speed Ace hauling units and a 1¼-yard Northwest loaded to three Koehring Dumptors. The four bottom-dump Speed Aces were used on the longer hauls and the Dumptors worked in the solid rock. The scraper teams consisted of a 7-yard Continental scraper pulled by an A-C Model L tractor and a 12-yard LeTourneau Carryall pulled by a Caterpillar D8. For general roustabout work and for spreading the fills, two A-C Model K tractors with Drott bulldozers were used, and a tractor-mounted Davey air compressor operating four air hammers was used for rock drilling.

Exceptionally heavy rains held up the job for two weeks at the end of June and made work practically impossible for all but one week during the month of September. The picturesque character of the country was no salve for the four Ryan brothers, Bill, Allan, Morris and John, who were on the job and took part in supervising the work. The job was located a few miles from where the Wisconsin River empties into the Mississippi. This country, while extremely hilly, is not rolling, as the hills take the form of "knobs," forming an attractive setting for the wide, modern highways now under construction.

Estimated Quantities

The engineer's estimate of the principal items on this job, Federal Aid Project No. 298, Contract 2, were:

Item	Quantity
Common excavation, earth	219,694 cubic yards
Rock excavation	38,354 cubic yards
Salvaged surface course	5,800 cubic yards
Finishing roadway	300 stations
Reinforced concrete pipe, 24-inch	912 feet
Reinforced concrete pipe, 30-inch	229 feet
Reinforced concrete pipe, 36-inch	350 feet
Reinforced concrete pipe, 42-inch	115 feet
Corrugated galvanized sheet metal pipe, 18-inch	308 feet
Corrugated galvanized sheet metal pipe, 24-inch	32 feet
Corrugated galvanized sheet metal pipe, 30-inch	60 feet
Cable guard fence	2,440 feet
Seeding	333,631 square yards

The unit prices on which the contractor's bid of $93,759.84 was based were:

Item	Unit Price
Clearing, per acre	$30.00
Clearing trees, per inch diameter	.16
Grubbing, per acre	40.00
Grubbing trees, per inch diameter	.16
Common excavation, earth, per cubic yard	.23
Rock excavation, per cubic yard	.545
Sand-gravel fill, per cubic yard	.45
Finish roadway, per station	11.40
Obliterating old road, per station	5.00
Obliterating temporary road, per station	5.00
Salvaging surface course, per square yard	.25
Mortar rubble masonry, per cubic yard	6.00
Dry rubble masonry, per cubic yard	4.00
24-inch reinforced concrete pipe, per foot	3.56
30-inch reinforced concrete pipe, per foot	5.00
36-inch reinforced concrete pipe, per foot	6.61
42-inch reinforced concrete pipe, per foot	7.91
Riprap, per square yard	1.90
Grout riprap, per square yard	3.50
Mortar rubble masonry ditch checks, per cu. yd.	7.00
Special concrete connections, per cubic yard	40.00
Cable guard fence, per foot	.74
Anchorages, each	11.00
Marker posts, each	1.90
Seeding, per square yard	.005
Sodding, per square yard	.40

Labor

The minimum wages for labor under the following classifications on this job were between the following ranges:

Skilled labor.....from $0.70 to $1.50 per hour
Intermediate grade labor.....from $0.50 to $1.35 per hour
Unskilled labor.....from $0.50 to $0.60 per hour

The contract called for a 40-hour week for labor, with no limit on equipment. The contractor worked 1½ shifts or 12 hours per day.

Personnel

Following the completion of this contract, Ryan Brothers moved on to State Trunk Highway 35, just north of Prairie du Chien, where they completed another job very similar in character. On the new contract the road parallels the Mississippi River along the route of Crawford County Trunk F and forms an important link in the road from Prairie du Chien to LaCrosse by eliminating the hilly winding road now in use along Route 35 between Prairie du Chien and Lynxville. On both these contracts all four of the Ryan brothers were on the job, with Bill and Allan most active. For the Wisconsin Highway Department, G. L. Bergh was Resident Engineer.

Death Strikes on Roads That Are Dark At Night

A very rational illustrated folder showing how highway lighting does save lives has been prepared by Line Material Co., South Milwaukee, Wis. This well illustrated, intelligently prepared booklet, "When Night Falls—Death Strikes," contains material, information, illustrations and ideas which should be in the hands of all highway officials and engineers, and particularly those responsible for highway traffic safety. Send for a copy of Bulletin LMB-3931 and mention this magazine.

The New Chausse Helhete Kettle

Low Center of Gravity Features Heating Kettle

A new melting and heating kettle known as the Helhete is now being made in capacities from 60 to 300 gallons by Chausse Equipment Manufacturers, 80 East Jackson Blvd., Chicago, Ill., and Detroit, Mich. This kettle has an extremely low center of gravity and a loading height of only 45 inches. It is mounted on elliptic springs supported by a drop axle and is carried on 6.00 x 16 6-ply rubber tires. The water and fireproof covers and heavy metal firepot may be removed for easy cleaning.

The sides, top and bottom are of heavy sheet metal, mounted on a heavy reinforced frame of angle iron with all of the seams electric welded. The cast insulation, 1½ inches thick, is of asbestos base and is fireproof and heat retaining, so insulating the kettle that with a fuel consumption as low as two quarts an hour bituminous material is heated to the proper temperature in thirty minutes, according to the manufacturer. A copy of the latest Chausse catalog may be secured direct from the manufacturer or through this magazine.

Want any information on equipment? Write the Editor.

A-C Type Electrodes

A-C crucible weld electrodes for every requirement are described in a new booklet issued by the Westinghouse Electric & Mfg. Co. Included are electrodes for low or medium carbon steel welding, for cast iron welding, for stainless steel, hard surfacing and for manganese steel. Copies of this booklet, 26-650, may be secured by those interested direct from the Westinghouse Electric & Mfg. Co., East Pittsburgh, Penn., by mentioning this item.

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"For use where power is not practical or available"
Manufactured in 2, 5 and 15-Ton Sizes.
For capacity comparison, ½" cable used:
2-Ton "Lightweight" ..... 75 ft.
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15-Ton Triple-Geared "Special" ....1200 ft.
Patent instant gear change and positive internal brake that never fails, and will lock load.

Gear Ratios	Weight	Price, f.o.b. Seattle
2-Ton 4, & 22 to 1	60 lb.	$ 50
5-Ton 4, & 24 to 1	110 lb.	$ 75
15-Ton 4, 19 & 109 to 1	680 lb.	$250

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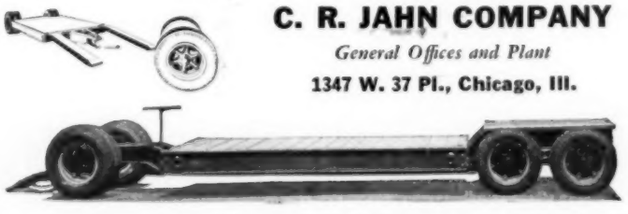
HERE is trailer capacity up to 45,000 lbs. with the ease of loading that comes with light, single purpose trailers—just drop the front, load and jack the bed up and replace the wheels. This feature, combined with other Jahn Trailer advantages, means new speed. There are no ramps to build and the load can be definitely placed without fuss or maneuvering.

The loading platform is low and flush with outer channel. Tires are standard, available anywhere. Brakes, loading ramps, lash rings, stake pockets, safety chains, reflectors and flag sockets are standard equipment. Standard width is 8 ft., and either tandem or dual oscillating rear axles may be had. Other types and sizes up to 60 tons capacity. Don't buy a trailer without investigating Jahn Trailers.



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Methods to Prevent Frost Boils in Roads

(Continued from page 15)

water by a layer of coarse material or by an impermeable layer.

3. Decreasing the depth of frost penetration and heave by a heat insulating material.

4. Excavating the soil and replacing it by a non-frost heaving soil.

5. Chemical treatment of the soil.

Drainage

How may these principles be used practically to prevent or diminish frost damage? The most general and important method is by proper drainage, the effect of course being to lower the ground water table which diminishes the amount of heave, and also to drain the excess water released by thawing. Drains installed to prevent or decrease heave must be placed at a sufficient depth below the road bed to keep the ground water level at the desired elevation. Generally these drains can be expected to decrease heave only to a nominal permissible magnitude, since they cannot remove capillary water, and since the capillarity of frost-heaving soils lies between 4 and 30 feet.

Cases in which such drains can prevent heave entirely are those in which the soil is comparatively coarse (capillarity less than the depth of drainage) and those in which the heaving soil lies on top of a coarser soil, so that the subdrain will cut down sufficiently into the coarser soil to "break" the capillarity. Deep drainage can be very effective on side slopes. Here the drains should be laid on the up-slope side of the road under the surface drainage ditch, where it can intercept the high ground water and lower it under the road bed to the level of the bottom of the drain (Figure 2). Such a drain generally consists of a trench 6 feet or more in depth filled with gravel or coarse sand, at the bottom of which a tile drain is placed.

Replacement of Soils

Where it is necessary to prevent heave entirely and the ground water cannot be lowered sufficiently by drainage to accomplish this, either excavation and replacement by non-frost heaving soil or insulation must be resorted to. Excavation to the entire frost depth and placing of new material is an expensive process and may not be economical. In many cases it is cheaper to place a layer of very stiff clay underneath to prevent any upward flow. Where this is done, it is absolutely necessary that this tight layer is not at any time below the ground water table, for then it would be useless.

Heat insulating materials have been used quite successfully in some places. Peat moss placed near the surface was found to work well in preventing frost penetration. On slopes of cuts where mud flows caused by excessive water content may induce slides or slumping, thus blocking the road and side ditches, the formation of thick ice layers may be prevented by insulating the slopes with a few feet of cinders or by sodding.

Use of Chemicals

Experiments have shown that certain chemicals added to soil decrease the amount of heaving very materially, but their successful use in the field on roads has not yet been demonstrated.

Study Heaves—Then Apply Cure

These are only a few of the many things that can be done to eliminate frost damage. The particular solution for any specific case depends upon the local conditions. When applying a solution to this problem, the important thing is to keep the general principles of the causes of frost heaving clearly in mind. In some instances where highway engineers did not consider the actual causes of heaving when applying a cure for their road troubles, conditions were made worse rather than better. Careful studies should be made of places causing trouble before any remedy is tried. Sometimes, trial drains can be installed over a small area to see if they are effective. When locating new roads, careful soil surveys should be made in order to plan the construction properly to avoid frost damage. With proper drainage and control of fill material, most frost heaving problems will be solved automatically.

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B.P.R. Changes Name And Joins the F.W.A.

The U. S. Bureau of Public Roads has had a long and honorable career under various titles, beginning with The Office of Road Inquiry created by the Secretary of Agriculture in 1893 and then the Office of Public Roads in 1905. On July 1, 1915, the appropriation act for that year changed the Office of Public Roads to the Office of Public Roads and Rural Engineering. This name was changed on July 1, 1918, by the same authority, to the Bureau of Public Roads, and in May, 1919, Thomas H. MacDonald was appointed Chief.

On June 24, 1939, the Bureau of Public Roads became a part of the newly-formed Federal Works Agency, along with the Works Progress Administration, The Public Works Administration, the Public Buildings branch of the Procurement Division, the Buildings Management branch of the National Park Service, and the U. S. Housing Authority.

The President's reorganization order of April 25, 1939, creating the Federal Works Agency and two other new agencies, was confirmed and made permanent on May 3 when the House of Representatives, by a two-to-one vote defeated a resolution of disapproval. Therefore, in the future, the Bureau of Public Roads will be known as the Public Roads Administration, and will operate under the direction of the head of the new agency, the Federal Works Administrator, instead of the Secretary of Agriculture. The present Chief of the Bureau, Thomas H. MacDonald, will continue in charge with the title Commissioner of Public Roads.

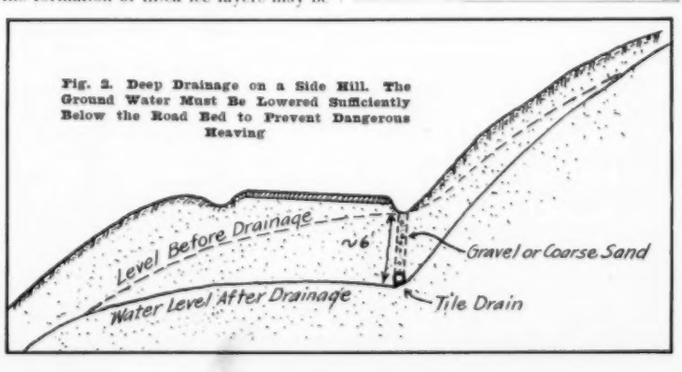
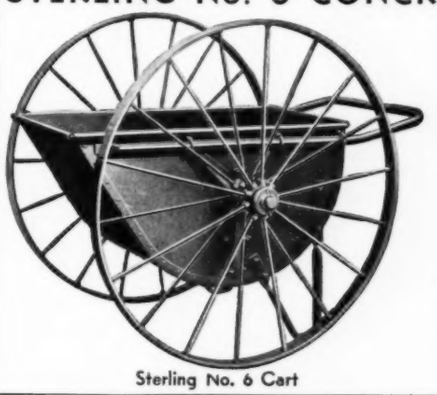


Fig. 2. Deep Drainage on a Side Hill. The Ground Water Must Be Lowered Sufficiently Below the Road Bed to Prevent Dangerous Heaving

STERLING No. 6 CONCRETE CART



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42" dia. wheels
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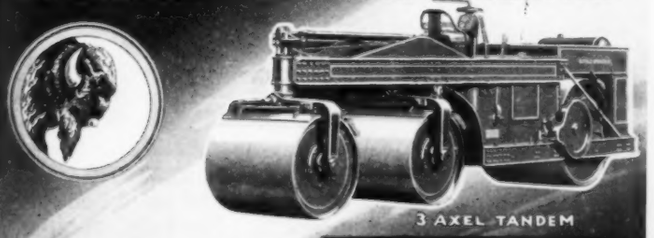

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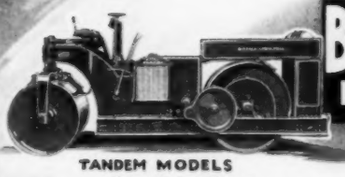

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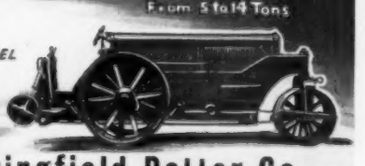

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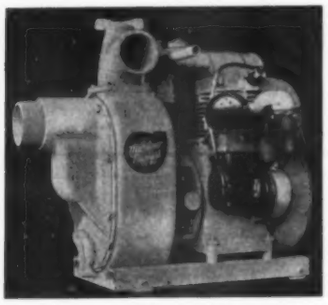

The Marlow Light-Weight 3-Inch Self-Priming Pump

Aluminum Parts Used In Self-Priming Pump

In order to secure light weight for its 2 and 3-inch self-priming pumps, Marlow Pumps, Ridgewood, N. J., uses aluminum for the pump parts and also for many of the engine parts. This reduces the total weight of the 2-inch pump to 97 pounds, including the 2-hp air-cooled engine, and the weight of the 3-inch pump to 104 pounds. The nominal ratings for the two pumps are 8,000 and 15,000 gph respectively. The engines are of the 4-cycle type with independent magneto and impulse coupling, speed changer and rope starter. The 2-inch pump is powered with a Model AA Wisconsin 2¼-inch bore x 2¾-inch stroke, and the 3-inch pump has an ABS Wisconsin 2½-inch bore x 2¾-inch stroke.

The manufacturer states that either pump will handle a total head of 50 feet, including the suction lift and friction, and they are self-priming up to 25-foot suction. The front cover of the pump is readily removable, providing full access to the interior of the pump and each is fitted with the special Marlow Type S shaft seal which eliminates packing. Complete information and further details on these pumps are available direct from Marlow Pumps.

Giant Pile Hammers For Bridge Project

The heaviest pile-driving hammers ever built have just been constructed for Merritt-Chapman & Scott, general contractor of New York City, for use on the substructure of the new Potomac River Bridge, formerly known as the Morgantown Bridge, between Ludlow Ferry, Md., and a point near Dahlgren, Va. The contract for two pile hammers with 14,000-pound rams was awarded to McKiernan-Terry Corp., 19 Park Row, New York City.

One of the Specially Built McKiernan-Terry Pile Drivers for Use on the Potomac River Bridge

The total weight of each hammer, with special anvil blocks for driving the fabricated steel piling for the bridge, is 16 tons. Each will deliver an impact of 37,500 foot-pounds, at the rate of 55 to 60 blows a minute. The hammer is 16 feet 7⅛ inches overall height, is 36 inches square, has a 20-inch cylinder and 7-inch piston rod with a 32-inch stroke, and operates on 100 pounds steam pressure at the hammer. Specially designed for underwater driving, the hammer stays on the piling to penetration under 90 feet of water without the use of a follower. The same hammers will be used for the piers and approach bents.

One of the hammers is mounted on a special boat, braced and rigged to carry at the bow a pile driver frame with 104-foot pendulum guides and extension leads for deep water driving. This unique equipment will permit driving 100-foot steel piles not only vertically but at angles to give spread to the foundations. This special derrick with hammer, guides and bracing will weigh more than 200 tons.

The Merritt-Chapman & Scott contract for the substructure of the Potomac River Bridge involves the construction of the west abutment, 59 approach trestle bents and 20 piers in deep water and is scheduled to be completed in February, 1940. The overall length of the bridge will be nearly 2 miles and it will provide an important new highway across the Potomac, by-passing the congestion around Washington for through north-south traffic and shortening by several miles the route from southern points to Baltimore, Philadelphia and New York.

Diesel Nozzle Tester Cleans Them on Job

A new hydraulic diesel nozzle tester, a precision instrument for accurately testing and cleaning fuel-injection nozzles manufactured by Bosch, Timken, Deco and others, has been announced by The Buda Co., Harvey, Ill. The Buda machine tests and cleans nozzles out on the job, which means little time lost and no expensive service charges.

The instrument comes complete with a handle, two adapters for different size nozzles and complete instructions for operation. It is packed in a substantial wooden box with a carrying handle and provision for a padlock. The tester has a diesel oil reservoir with ample capacity for testing twenty to twenty-five nozzles, an accurate gage calibrated up to pressures of 3,500 pounds per square inch, a one-piece leak-proof body, and other special features which will be of particular interest to state highway department district maintenance superintendents and to contractors with fleets of diesel-powered equipment. Complete information will be found in Bulletin No. 958, which may be secured direct from The Buda Co. or through this magazine.

Free Cost-Record Book For Power Equipment

Whether it is a tractor, a power unit or the engine on a piece of construction machinery that you want to keep track of and find out all about what it is costing you, you can make use of the Industrial Power Cost Record which has recently been made available by International Harvester Co., Inc., 180 North Michigan Ave., Chicago, Ill. This simple industrial power cost record book makes it possible for an owner to obtain, with practically no extra labor, an accurate and comprehensive statistical picture of how the power equipment is operating and how much each tractor or each stationary engine is costing.

For use with this book a 4¼ x 6¼-inch printed form is filled in daily by the tractor or engine operator to secure the records. Both these drivers' daily report forms and the cost books are available free of charge to readers of CONTRACTORS AND ENGINEERS MONTHLY whether they operate International equipment or not. Send for a copy of the cost record book and a pad of fifty forms today so that you can check up on your costs and know where you stand before this working season is over.

Austin-Western Plant And Executive Changes

Along with plans to erect additional buildings and to consolidate manufacturing facilities at Aurora, Ill., announcement has been made by S. F. Beatty, President of the Austin-Western Road Machinery Co., of several executive changes to increase the efficiency and coordination of the entire organization.

F. L. Jerome, Vice President, has been made Assistant to the President; H. M. Kleiser, Vice President, has been placed in charge of sales, advertising, service and research; R. K. Stiles has been made Sales Manager; and A. O. Teckemeyer will become Manager of the Governmental Sales Division.

About 18 months ago Austin-Western changed from distributing its products through coast-to-coast branch office sales organizations to distributing its complete line of road-building, rock-crushing, earth-moving and street-cleaning machinery through a large number of well-known machinery equipment dealers located throughout the United States and in all parts of the world.

It's a SPEEDLINE

Latest Type Speed Mixers!

Fastest, easiest handling, lightest yet huskiest mixers Jaeger has ever built — end discharge trailer type (2 or 4-wheel mountings interchangeable), need 50% less street room. *Machined Steel Drum Tracks*—many improvements. Low prices. Get Catalog.

THE JAEGER MACHINE CO.
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JAEGER

Manufactured by
HETHERINGTON & BERNER Inc.
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COMBINED IN THE NEW MODEL P-A PORTABLE MIXING PLANT

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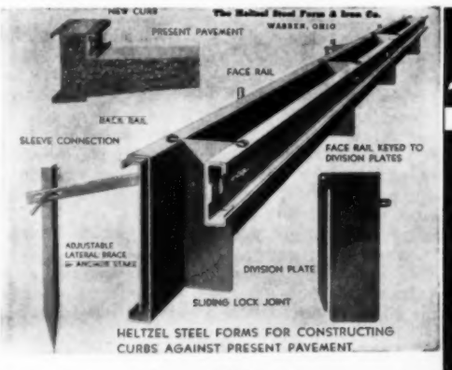

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● Note simplified means of holding face form rigidly in place when constructing curbs against pavement. Exclusive with Heltzel steel forms.

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BUILDS IT BETTER

BINS, Portable and Stationary
CEMENT BINS, Portable and Stationary
CENTRAL MIXING PLANTS
BATCHERS (for batch trucks or truck mixers with automatic dial or beam scale)
BITUMINOUS PAVING FORMS
ROAD FORMS (with lip curb and integral curb attachments)
CURB FORMS
CURB AND GUTTER FORMS
SIDEWALK FORMS
SEWER AND TUNNEL FORMS
CONCRETE BUCKETS
SUBGRADE TESTERS
SUBGRADE PLANERS
TOOL BOXES
FINISHING TOOLS FOR CRETE ROADS

HELTZEL STEEL FORM & IRON CO.
WARREN, OHIO, U.S.A.

Many Delays Occur On Alaska Road Job

(*Continued from page* 11)

hard frosts.

Other difficulties included the fact that the freeze-up was likely to come any day, the local road superintendent was ill with lumbago, the local foreman had heart disease and, as he weighed over 300 pounds, could get around on a new job only with the greatest discomfort. In addition, the local road organization was not at all in sympathy with starting a project at a time of year when their work is ordinarily completed. Also there was a certain amount of protest on the part of the mining people against the route selected, for business and sentimental reasons, in spite of the fact that the road was being constructed by the government for their particular benefit. Cooperation was nil.

On October 2 there were waiting at McGrath an Allis-Chalmers KO with Isaacson bulldozer, a 2-yard Atlas tumbler and a new D6 with bulldozer. The same day the only possible transportation left McGrath and started upstream for Takotna. Due to the cold weather, the water was gradually falling. Arrangements were made with the outfit, which consisted of a small stern-wheel gas boat pushing an old barge much too large for the boat and the crooked stream it had to navigate, to pick up a Caterpillar Forty with a LeTourneau bulldozer at Takotna, return to McGrath, load on the other equipment, with fuel oil and other supplies, and proceed down the Kuskokwim River 23 miles to start the work at the terminus of the road.

The little boat had its usual bad luck in arriving at Takotna on a rapidly falling stream and due to one difficulty and another, finally arrived at McGrath on the 17th, with the crew and even the boat and barge apparently worn out.

The Forty was unloaded at the end of the swamp road then being used by the mining camp. From there, with the aid of one of the miners' tractors handled by an experienced operator who knew the road, it was pulled, dragged and slid over the 9 miles to the mining camp. The other two tractors arrived on the 19th.

Some days before, a slip had been dug in the low bank by a clearing crew which had started work shortly after the survey was begun. The water had dropped more than 3 feet and although the slip was corduroyed over the rotten moss and vegetation, the whole thing looked rather precarious for unloading. The KO was safely taken across the gap between the barge and the slip on two 12 x 12 x 16-foot timbers and, after climbing the steep slip, landed on the swampy rain-soaked bank.

In moving the larger and heavier D6, a part of the slip caved in, one timber slipped sideways and downward and the tractor settled comfortably into the slime and ooze in the edge of the water. A new ¾-inch wire rope was fastened to it and to the KO. But during the attempt to pull it out, the rope broke and the D6 settled back heavily, sinking deeper into the water. The KO could no longer get footing on the bank, in spite of corduroy being placed under it. The D6 lay at an angle of 45 degrees, the water up to the top of the back of the seat with the front end of the tracks deep in black muck. Ice was due in the river at any time, and the tractor did not belong to the Road Commission. Something had to be done right away, but the KO could do nothing for lack of traction and, for the same reason, the D6 was powerless.

Radio and Plane Help

In a biting wind, the engineer made the 3-hour trip upstream to McGrath in an outboard-motor boat. The commercial radio station was out of commission, but at 5 o'clock a friendly aviator radioed his base at Anchorage. Consequently a plane arrived the next afternoon, bringing a 5-ton chain block and steel sheaves with cable. This equipment was taken on down the river the same afternoon and arrived at camp after dark. Shortly after lunch the next day the D6 was on the bank undamaged and before the day was over was stripping moss and trees off the right-of-way. But for the radio and plane, this tractor would probably even now be reposing at the bottom of the Kuskokwim River.

Progress Slow But Sure

It had taken 21 days to get started on the job, whereas under favorable conditions and weather, the 8 miles to the placer camp could have been opened as a tractor road in about that length of time.

Work now began in earnest, in spite of the rain-soaked ground and snow. Two tractors were employed at the river end and three worked at least part time from the mining camp. It was found that a wide-gage wide-track D7 could strip ground that left a standard Forty hopelessly mired in muck, while contrarily a little Caterpillar Twenty-Two could snake out bridge timbers from where the D7 dared not go.

Most of the equipment was in poor condition after a full season's work with only such repairs as were absolutely necessary to keep it running. Consequently, although the work was not closed down until December 7 (the autumn having turned out exceptionally mild), every tractor was disabled except the new D6. The crew did manage, however, to open a passable tractor road over the 8 miles which, after all, was what they started out to do. In addition, a mile and a half of new road was built on the Takotna end of the project.

Depending upon appropriations, it is hoped that, except for bridges, the entire 22.5 miles will be opened as a tractor road by the autumn of 1939 and that the following year trucks will be rolling over the road and saving the miners $20 on every ton, as compared with the cost of the old river route. Its completion will also guarantee dependable transportation during the summer.

New Leaning-Wheel Grader

The Galion Iron Works & Mfg. Co., Galion, Ohio, has recently introduced an entirely new leaning-wheel grader, the No. 210, which, according to the manufacturer, reflects years of sound engineering and design. It is a manually-operated 7,765-pound unit equipped with a 10-foot moldboard and patented E-Z lift manual control. Among its outstanding features are centralized controls; an extreme range of blade adjustments for shoulder, high bank and vertical angle cuts; a rigid box-type frame providing full visibility of work; a newly designed circle assembly and single mechanism for side shift and high lift.

Each of these features is described fully and illustrated in Bulletin No. 234, copies of which may be secured direct from the manufacturer.

Two-Speed Axle Aids Moving of Aggregate

W. E. Anderson & Co., Columbus, Ohio, sells sand and gravel for general construction. Last year it added six Ford V-8 dump trucks with two-speed axles and special bodies to its fleet of hauling trucks of various sizes and makes. Carefully kept records clearly show that the two-speed-axle-equipped trucks are delivering material at less cost, because the greater pulling ability, reductions in time required to complete round trips, reduction in wear and tear on machinery and tires, and reduction in fuel consumption all add their bit. W. E. Anderson & Co. reports that these trucks are hauling about 25 per cent more material than the other trucks per trip. One unit moved 72 tons of material in one day on a 20-mile round trip; another 86 tons in one day on a 15-mile round trip; while still another moved 105 tons in one day on a 7-mile round trip, each of the days referred to being a 9-hour day.

Bulldozer Grades Bank And Shifts Dump Track

A novel piece of equipment which can be used for grading any spoil bank or embankment built up by dumping from an industrial or standard-gage railroad track has been developed as an aid to construction by the Timken Roller Bearing Co., Canton, Ohio. In disposing of slag from the Timken steel plant, a bulldozer and special job mounted on a 95-hp Caterpillar tractor was put on the job. When the slag from the mill is dumped along the edge of the pile from railroad cars, the tractor drops the blade of the special bulldozer over the track right at the edge of the ties. The blade is allowed to sink down until the push arms rest on the rails. With the rails supporting the blade and holding it to the grade line, the hot slag is pushed over the edge of the bank. As the pit is filled in, the tractor shifts the railroad track over onto the fresh fill which is at proper grade.

The special tool consists of a standard bulldozer blade for 35-hp tractors mounted on arms that extend it approximately 17½ feet in front of the tractor idler. The cutting edge of the blade is 13½ inches below the bottom of the push arms.

An Unusual Method of Bulldozing

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SPEED AND EASE OF HANDLING AND PHENOMENAL RUGGEDNESS . . INSURE THE PAY-OFF.

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1 YARD
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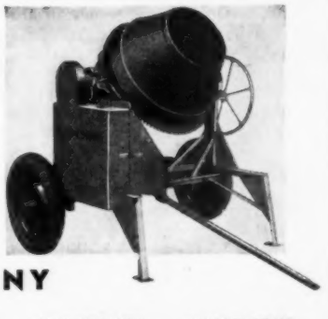
the genuine Crosby Clip
THE SAFE FASTENING FOR WIRE ROPE

A New Mixer Built for Action

This new 3½ E.D. (End Dump) Lansing Trailer Mixer is faster, more compact and easier handled. Its overall length is only 57" and entire width 68", with a height of 65".

It has a convenient shoveling height of only 42½", with a 31-inch drum. Sturdy 1⅞" axles, and 26" wheels with pneumatic tires. Weighs only 950 lbs. Write or wire NOW for complete information.



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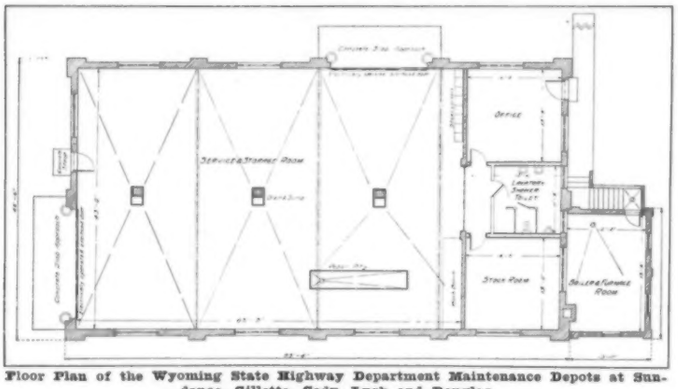

Floor Plan of the Wyoming State Highway Department Maintenance Depots at Sundance, Gillette, Cody, Lusk and Douglas

Maintenance Depots For Wyoming Highways

(*Continued from page 21*)

face brick exteriors and common brick interiors; twenty-year-bond Johns-Manville 4-A-1 roofs on Truscon decks supported by I-beams; reinforced concrete floors; electrically operated storage and service-room doors, two in each building. All electrical fixtures are of the latest type, and wiring is installed in metal conduits. All buildings are steam heated, using natural gas or stoker-fired coal for fuel. Blower-type unit heaters with aquastatic control are placed overhead in the storage and service rooms. Conventional-type cast-iron wall heaters, thermostatically controlled, are installed in the offices, lavatories and stock rooms. Large-capacity water heaters supply hot water to the wash racks in the service rooms and to the lavatories. Spacious windows in all rooms make possible the use of natural light to the best advantage.

The stock rooms are fitted with metal shelves and bins for tools, parts and expendable supplies. Offices are furnished with desks, tables, filing cabinets, chairs and stools. The storage and service rooms contain wash racks, work benches, large-capacity compressors, chain hoists, pressure greasing equipment, electric tool grinders, electric drills, individual steel lockers, and other articles in daily use.

The lots upon which the buildings are located are sufficient in size to provide for the storage of stock material required for road repairs, heavy non-motorized equipment and oil tanks. For protection the yards are fenced with 94-inch V-mesh wire fence of pleasing design, and for appearance landscaping has been planned.

The maintenance depots were built by contract, all work being supervised by the designing architect or engineers employed by the Highway Department. The accompanying table shows the costs of the seven completed depot projects.

Care of Equipment

Shops located at each district headquarters are well equipped for all kinds of major repairs and reconditioning of equipment. Only in emergencies are major repairs made at the maintenance depots. The district shop mechanics make frequent visits to the depots to check, adjust and make light repairs on cars, trucks and road machinery being used in that vicinity. The personnel of the unit organizations attends to the regular servicing of equipment used by them.

The economical operation of road equipment is largely dependent on its proper care. Warm storage facilities are essential for efficient operation of the equipment used in the winter months, particularly the trucks and plows on snow removal work. At other times of the year, the storage rooms are often converted into work shops where sign painting, carpentry work, painting of equipment and many other odd jobs are carried on.

These new maintenance depots are proving a boon in furthering our efforts toward more efficient and economical operations in Wyoming.

COST OF MAINTENANCE DEPOTS CONSTRUCTED BY THE WYOMING STATE HIGHWAY DEPARTMENT DURING 1937 AND 1938

Location	Size of Building	Contractor's Final Estimate	Prelim. Engr.	Const. Engr.	Misel. Added Value‡	Cost of Lot	Misel. Work Done By State Force*	Total
Cody	46'-6" x 83'-6"	$ 20,415.40	$ 299.90	$1,210.33	$ 205.61	$ 318.50	$ —	$ 22,499.74
Gillette	46'-6" x 83'-6"	21,825.88	300.22	912.03	726.88	30.10	83.18	23,878.29
Sundance	46'-6" x 83'-6"	22,926.73	162.80	979.75	233.23	295.85	88.97	24,687.33
Lander†	55'-6" x 103'-6"	26,602.00	597.28	353.76	76.81	793.00	—	28,422.85
Douglas	46'-6" x 83'-6"	20,781.52	400.33	317.27	810.83	960.50	90.72	23,361.17
Lusk	46'-6" x 83'-6"	20,445.90	334.48	773.85	107.65	782.71	739.98	23,184.57
Rawlins	55'-6" x 83'6"	27,320.95	613.43	542.60	2,524.94	536.50	—	31,528.42
TOTALS		$160,318.38	$2,708.14	$5,089.59	$4,685.95	$3,707.16	$1,002.85	$177,512.37

† This building recently completed and costs shown are estimated.
‡ Lockers, cranes, furnishings and other new equipment.
* Leveling yard site, moving equipment, etc.

Shasta Order Starts A New Cement Plant

(*Photo on page 40*)

To get a lump order for 5,800,000 barrels of cement is something! To get it before you have a cement plant built is something still more! Credit for this unusual accomplishment goes to Henry J. Kaiser of Oakland, Calif., whose recently formed Permanente Corp. was awarded the contract on June 10 for all the cement going into Shasta Dam, the major structure in the U. S. Bureau of Reclamation's Central Valley Project in California. The price is $1.19 a barrel at the yet-to-be-built plant, or $1.90 a barrel delivered at the dam. This is said to be the lowest bid price for cement received by the United States Government for any of its large dam projects.

The specifications of the Procurement Division in Washington, Schedule 2, called for the above quantity of low-heat cement, enough to meet the estimated requirements for the completion of the dam. Deliveries are to be started in time for placing the first concrete, expected to be in March, 1940, at a uniform rate of 100,000 barrels a month and estimated fluctuating requirements in excess of 100,000 barrels a month.

For a long time Mr. Kaiser has had his eye on a deposit of cement rock at Los Altos, Calif. Seizing upon the opportunity presented by the construction of Shasta Dam, which will be the second largest concrete structure in the world, he went after the order. This involved acquiring the rights to the quarry property, a permit from the Commissioners of Santa Clara County to erect and operate a cement manufacturing plant thereon, and the design of such a plant which will, incidentally, cost approximately $4,000,000. Satisfying the Bureau of Reclamation on these points, and that sufficient cement could be produced, he submitted a bid which was considered with all others.

His bid, being the lowest, got the award and Mr. Kaiser is now in the cement business on a very definite basis, his first order amounting to the sum of $6,902,000 f.o.b. plant.

Portable Arc Welders

Hobart gas-engine and electric-drive portable arc welders are fully described and illustrated in a new two-color booklet recently issued by Hobart Bros. Co., Box CE-59, Troy Ohio. Copies of this bulletin may be secured by writing direct to the manufacturer, or from CONTRACTORS AND ENGINEERS MONTHLY.

Do you wish a really superior dumping unit for handling 2-cu. yd. Detachable Buckets?
SEE OUR MODEL LF
(Load Forward)
DEMPSTER DUMPSTER
For any 1½-ton truck
NO COUNTERWEIGHT OVERHANG SIDESWAY
All the load on the chassis
DEMPSTER BROS. INC. Knoxville, Tenn.

KUE-KEN CRUSHERS - -
MORE THAN BACK UP OUR CLAIMS!
A No. 50 KUE-KEN is crushing 30 tons per hour of hard river gravel on a feed of 2 to 6 inches. This capacity is obtained with a ⅝" jaw setting making 95% minus 1 inch with only 40 h.p. The best the previous crusher could do (a well-known gyratory weighing over 3 times as much as the KUE-KEN) was 20 tons per hour to 1½" jaw setting. 50% of the product was oversize and had to be returned for recrushing.
Send today for Bulletin 600. Gives capacities, weights and power required for several sizes of crushers. Actual results obtained in the field are proving our established policy of conservative catalog ratings.
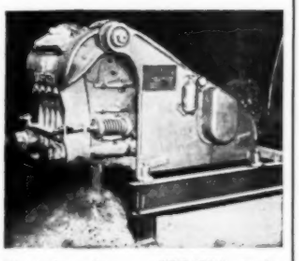
Illustration shows a KUE-KEN crusher which crushes faster and finer than ever before. The only crusher that is balanced and crushes without abrasion.
STRAUB MFG. CO.
532 CHESTNUT ST., OAKLAND, CALIF.

"JOINTS IN ROADS"
Living creatures have them—so have material things. Man at first tried to build concrete roads without them and failed. Both contraction and expansion joints are necessary. Command us.
FLEXIBLE ROAD JOINT MACHINE CO.
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Engine Driven Road Sweeper

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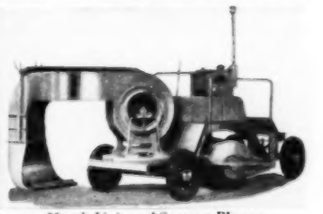
Hough-Universal Sweeper-Blower
Hough Sweeper-Blowers Eliminate Blister Worries!
Removing dust and fines from black top and retread road bases is a simple matter with a Hough Sweeper-Blower.
Cleans out the pockets on a hard base and removes all the fines on sand or clay base. One pass over and all "bubble" and "blister" worries are removed. Easy to operate, even by inexperienced labor. Frequently used to work one-half of road while the other side is open to traffic. Turn short and require little power. Ruggedly built for years of service.
You'll profit by writing today for Bulletins 110, 111 and 113—they tell the facts on the complete Hough Sweeper-Blower Line.
THE FRANK G. HOUGH CO.
919 N. Michigan Ave.,
Chicago, Illinois
HOUGH Since 1920

Arbitration Has a Place In Construction Industry

(Continued from page 27)

West Virginia, such an agreement, known as a submission, is enforceable only when it is made a rule of court; while in some states, such as Indiana, Kansas, South Carolina and Washington, the filing of a bond may be necessary to insure performance of the award. In only two states, Oklahoma and South Dakota, is there no general arbitration statute.

Preparing Arbitration Clause

One of the first requirements, therefore, of successful arbitration practice under these diverse laws is compliance with the law which will govern the proceedings, particularly in the preparation of the arbitration agreement, whether it Be an arbitration clause or a submission.

The arbitration clause should be examined carefully to see whether it provides adequate protection against the risks of avoidable litigation and the resultant economic waste. The clause recommended by the American Arbitration Association is as follows: "Any controversy or claim arising out of or relating to this contract or the breach thereof, shall be settled by arbitration, in accordance with the Rules, then obtaining, of the American Arbitration Association, and judgment upon the award rendered may be entered in the highest court of the forum, state or federal, having jurisdiction." It should be in the proper form, so it will be legally valid, irrevocable and enforceable; it should fully and clearly express the will of the parties; it should insure the appointment of impartial arbitrators, and it should provide adequately, by reference to the rules of an association or administrative agency, for a method of naming arbitrators and other necessary steps in the proceeding, thus safeguarding against deadlocks or defaults in the proceeding.

There is also a correct and an incorrect way of making a submission, and the penalty of technical errors made in disregard of the arbitration law may be the annulment of the award. The submission should state precisely the matter in dispute and the exact questions that are to be determined by the arbitrators; it should be signed by the parties or by their properly authorized representatives, with their signatures duly acknowledged whenever so required by the prevailing law; it should prescribe a method of naming impartial arbitrators so that if the persons named cannot (or refuse to) serve, a lapse in the proceedings will not result; it should refer to specific rules or procedure so that important questions relating to hearings, notices to the parties, taking of evidence and other important technical matters are not left to the arbitrators to decide, for if they are, differences over technicalities may take precedence over the actual settlement of the controversy.

The question is sometimes asked whether a submission is required in addition to the arbitration clause. Under laws which make the clause legally valid and enforceable, (see above list of thirteen states having such laws) a submission is neither necessary nor desirable. On the other hand, if the clause is not legally valid and enforceable, under the prevailing arbitration law, a submission is necessary. Under these latter circumstances, the most that can be claimed for the clause is its moral effect upon the disputants. Business men of integrity will honor their contract obligations, and the mere presence of an arbitration clause predisposes the parties more readily to enter into a submission and has a good moral effect in favor of arbitration.

Arbitration in Construction Field

The engineering construction field is in much the same situation, as concerns a universal practice of arbitration, as the building construction was years ago. Both groups have strong, central organizations through which questions of policy and administration may be formulated; large and important projects are covered by the contracts of their members; their undertakings embrace all parts of the country, and delays in these projects are extremely costly and disastrous. It will therefore be of interest to see what efforts have been made to deal with the problem by the two branches of the industry.

Most engineers are familiar with the Standard Documents of the American Institute of Architects. This is an instrument devised by architects to maintain commercial peace in the industry by means of a uniform set of papers embodying formally the several contractual rights and obligations relative to a building contract, so carefully drawn and so explicit in its terms that it reduces to a minimum the chances for misunderstandings and includes a well-defined provision for arbitration when controversies arise in the course of construction. This contract extends protection from litigation to the owner, the contractor and subcontractor, so they now have its benefits, and as it is used throughout the industry, these are widespread.

Many engineers will recall a move made in 1921 by a number of engineering and construction groups, when former President Hoover, then Secretary of Commerce, called a Joint Conference on Standard Construction Contracts, one of the purposes of which was "less expenditures for legal services in drawing proper contracts, and the elimination of disputes over contracts already drawn." Members of the Conference were: American Association of State Highway Officials, American Engineering Council, American Institute of Architects, American Railway Engineering Association, American Society of Civil Engineers, American Water Works Association, Associated General Contractors of America and Western Society of Engineers. Out of the Joint Conference grew two Standard Contracts, one for engineering construction and one for building construction, the use of which was not obligatory upon members of the Joint Conference, as they were merely intended as a recommendation and guide. Both of these Standard Contracts included provisions for arbitration.

The Building Construction Contract has been developed and improved under the sponsorship of the American Institute of Architects until, in the boom years, its sale in commercial form for use by architects, owners and contractors approached half a million copies a year. No record is available as to the extent of the adoption and use of the Standard Contract for Engineering Construction, but this field seems not to have kept pace with the growth of arbitration practice and the extension of modern arbitration laws under which this growth has occurred.

Arbitration in the Future

Many things have happened in the eighteen years since the Joint Conference was called which give encouragement and support to the advocates of the principle and practice of arbitration: the passage of new state laws and a Federal Law; establishment of a national standardized system of arbitration and a National Panel of Arbitrators; a vast amount of educational work opening up new fields of arbitration, and its endorsement and support by business men and by the bench and bar alike.

With this groundwork laid, the engineering construction industry would seem to be in a position fully to enjoy the benefits of arbitration and to erect on this foundation, side by side with the building construction industry, arbitration machinery available to the entire field throughout the country.

Concrete Arch Bridge Completed in Norway

Norway's largest concrete arched bridge, the Risöy Bridge, connecting Risöy and the City of Haugesund, was opened on May 14, 1939. Construction was started January 29, 1938, and continued for 354 days. This structure is Norway's longest arched bridge, with a span of 316.5 feet and a height of 82 feet. The total length from street to street is 1,312 feet, the bridge has a driving lane of 20 to 33 feet and there is a 5-foot sidewalk on each side. The bridge was built by Höyer Ellefsen and Stoltz Rothing & Co. A/S, at a cost of $223,440.

MALL 7000 r.p.m. gasoline engine vibrator on pneumatic mounting. Can also be used for concrete surfacing, pumping, sawing, drilling, sanding and grinding.

SAVE MONEY!
Get Better Concrete with Mall Vibrators

You save on cement by using more coarse aggregate and on labor by using fewer puddlers. One vibrator does the work of three or four men. A MALL vibrator pays for itself with these savings. At the same time you get stronger, denser and more durable concrete, a better bond between reinforcing steel and successive layers, and earlier finishing with a minimum of patching.
There is a MALL for every type of structure. We will gladly help you select the unit best suited for your job—no cost or obligation!

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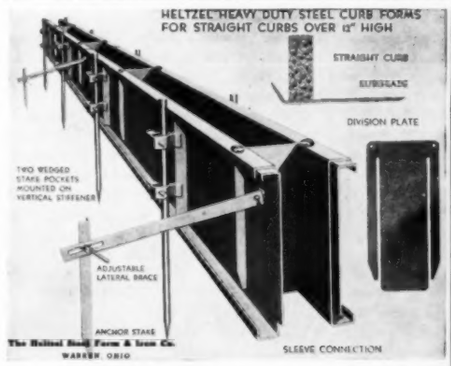
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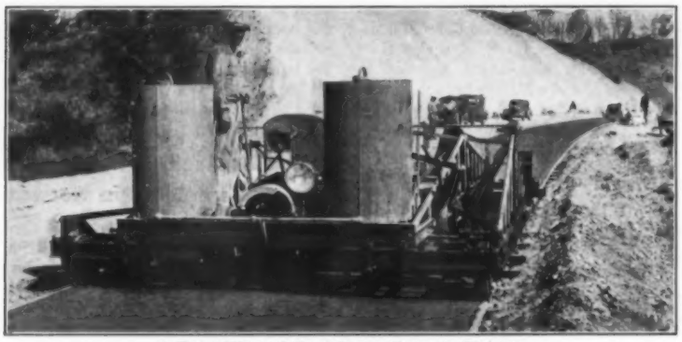

A Front View of the Johnson Concrete Finisher

New Float Finisher For Concrete Paving

A new float finisher which is generally used directly behind the strike-off or tamping machine, but has been used directly behind the paver after leveling by puddlers in localities where strike-off machines are not used, is now being manufactured by Madsen Iron Works, P. O. Box 109, Huntington Park, Calif. The Johnson finisher, designed to speed and improve the finishing of concrete pavements, travels forward and backward on the side forms, making up to six complete trips over the concrete to be finished. The average operating speed of the machine is about 100 feet forward per minute, but selective speeds permit rates from 10 feet per minute to 175 feet per minute. The capacity is such that it will easily handle the output of a dual-drum paver.

The principle of the Johnson finisher, for which Madsen Iron Works holds the manufacturing license for the eleven western states and Texas, is relatively simple. Four-wheel units, two of which are powered, carry the main frame at the corners. From the main frame is suspended a subframe to which are fastened the float members, which are generally made of Apitong, a tough wood that will not splinter. Other types of mahogany have been used with varying success. The float members are located in such a manner that two of them form an X-shaped member. A line bisecting the two acute angles of the X is also longitudinal with respect to the machine. Two V-shaped members are located at the sides of the X and the vertices of both are towards the center of the X. These members are all fastened to the subframe by 1-inch bolts and are vertically adjustable to allow the operator to set them to the proper cross-section. A fourth V-shaped member is located directly to the rear of the X member and is allowed to rest of its own weight on the concrete. This member is used only when the machine is traveling forward or towards the paver.

The subframe is vertically adjustable at the four corners by means of hand-operated levers. As the concrete is worked and subsidence takes place, the subframe and floats are lowered accordingly. A lowest position is marked in order that the floats during the final passes are always in the same plane, eliminating irregularities being caused by the float elevations.

At the center of the subframe is a self-contained unit which permits adjustment for vertical curves. This adjustment is necessary as the wheelbase of the finisher is approximately 23 feet.

At the front or powered end of the machine is an 8-inch diameter roller which depresses the large aggregate and brings the mortar to the surface. This roller can be raised or lowered as desired. Two 100-gallon water tanks and a spray bar are accessories that allow the concrete to be sprayed when the weather conditions require additional surface moisture to prevent checking. This equipment is used under the supervision of the inspector in charge.

The Johnson finisher is powered by a 60-hp 8-cylinder engine, power being transmitted through two gear boxes, a right-angled worm drive, and two telescoping drive shafts which permit width adjustments of the finisher from 10 to 13 feet. One operator handles the machine.

A.I.S.C. Announces 1938 Bridge Awards

(*Photos on page 4*)

The Eleventh Annual Awards for the most beautiful steel bridges built during the past year were announced on June 22 by the American Institute of Steel Construction. In first place, as the most beautiful monumental bridge, is the Middletown-Portland Bridge at Middletown, Conn.; the Capital Bridge across the Kentucky River at Frankfort, Ky., was judged the most beautiful medium-sized bridge; the bridge over the middle fork of the Flathead River at Belton, Mont., received the award as the most beautiful small bridge; and the Lafayette Avenue Bridge over the east channel of the Saginaw River at Bay City, Mich., was judged the most beautiful movable bridge.

For the purpose of classification, all bridges costing $1,000,000 or more were grouped in Class A; bridges costing less than $1,000,000 and more than $250,000 were grouped in Class B; bridges costing less than $250,000 to build were grouped in Class C; and all movable bridges were placed in a fourth class. In addition to the four prize-winning bridges, the Jury of Award selected four other bridges for honorable mention. In Class A, honorable mention went to the Bluewater Bridge over the St. Clair River between Port Huron, Mich., and Sarnia, Ontario. The Chain Bridge over the Potomac River between the District of Columbia and Virginia received honorable mention in Class B; in Class C, the Thousand Islands International Bridge between Constance and Georgina Island in the Canadian Channel of the St. Lawrence and the Burnham Park Pedestrian Bridge at the foot of East 47th Street, Burham Park, Chicago, Ill., were awarded honorable mention.

The Middletown-Portland Bridge, which received the Class A Award, and which cost $3,000,000 was designed by William G. Grove under the direction of L. G. Sumner, Engineer of Bridges and Structures, Connecticut State Highway Department; E. C. Welden, Deputy Highway Commissioner; and William J. Cox, State Highway Commissioner, and was fabricated by the Bethlehem Steel Co. The structure has a total length of 3,400 feet, with two steel arch spans of 600 feet each.

The Bethlehem Steel Co. also fabricated and erected the prize-winning bridge in Class B. This Capital Bridge at Capital Avenue, Frankfort, Ky., cost $329,316.39 and was designed by the Bridge Department of the Department of Highways of Kentucky. It has three spans of 67 feet and one continuous span of 474 feet.

The bridge over the middle fork of the Flathead River, which received the award in Class C, has three spans of 84, 168 and 84 feet and cost $74,815.25. It was designed by B. J. Orburn, Bridge Design Engineer of the Montana Highway Department and fabricated by the Pittsburgh-Des Moines Steel Co.

In the movable bridge class, the prize-winning Lafayette Avenue Bridge at Bay City cost $380,000 and has a bascule span of 185 feet and approach spans of 96 feet 10 inches and 107 feet 8 inches. The engineers were Hazelet & Erdal and the fabricator was the R. C. Mahon Co.

The Jury making the awards consisted of Graham Erskine, representing Arthur L. Harmon of Shreve, Lamb and Harmon, Architects; J. Andre Fouilhoux, Architect; Professor David L. Snader, Department of Civil Engineering, Stevens Institute of Technology; Kenneth Hayes Miller, Artist; and F. E. Schmitt, Editor of *Engineering News-Record*.

New Link-Belt Dealer

Link-Belt Co., Chicago, has announced the appointment of J. A. Riggs Tractor Co., 424 E. Third St., Little Rock, Ark., as authorized agent for Link-Belt Speed-o-Matic shovels—cranes—draglines.

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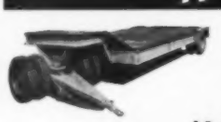

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County and State Rebuild Old Road

(Continued from page 18)

Surfacing

The final compacted base course after shaping to template was given a shot of 0.33 gallon per square yard of tar prime 21 feet wide. The prime at times ran as high as 0.35 gallon. Wherever possible, traffic was kept off the road following the prime to give it a chance to cure but where no detours were possible it was sanded at once with 10 to 15 pounds per square yard to blot it and broomed wherever it showed signs of bleeding. When surface treatment was to start, the sand blotter was broomed off to the sides and 0.4 to 0.42 gallon per square yard of asphalt of a penetration of 150 to 200 was applied to a 20-foot strip at a temperature of 275 to 350 degrees. The penetration specifications varied according to the time of year, that is according to the average air temperature, as follows: April 1 to June 1, 180 to 200; June 1 to September 10, 150 to 180; and September 10 to October 15, 180 to 200.

The asphalt was immediately covered with ½ cubic foot of gravel of 1 to ½-inch screen size referred to as the coarse aggregate. The gravel for this work was brought in by barge at the lower end of the job although some for the upper end came in by rail. The gravel which was spread directly from the tail-gate of the truck was then hand-broomed where necessary and rolled longitudinally with a Galion 5-ton tandem roller. The surface was then opened for traffic compaction for a period of not less than 14 days and then sealed with a plant-mix seal at the rate of not less than 35 pounds per square yard. This was spread with a combination spreading and finishing machine and rolled with a 7-ton roller. Just prior to placing the seal coat, a tack coat of 0.10 gallon per square yard of RC material was applied. The finished surface was then covered with 6 pounds per square yard of local sand and dragged with burlap. The local sand did away with all bleeding. The road was then opened to traffic.

Shoulder Treatment

Great care was taken in preparing the shoulders for a full growth of grass was necessary because of the readiness with which the soil washes, but the thoroughness of preparation was well rewarded with a fine stand of grass. After the shoulder was finished to the required slope a series of trenches about 12 inches apart were plowed 3 to 4 inches deep along the shoulder. Then 4-8-4 fertilizer and grass sprigs were placed in the trenches, the trench covered, dragged with a clapboard drag, rolled with a 12-inch diameter roller made of a corrugated iron pipe filled with concrete, and when the grass started to grow another application of fertilizer was made. The first fertilizer was applied at 600 pounds to the acre and the second, nitrate of soda, was applied at 300 pounds per acre.

Equipment

The equipment used on this project consisted of county and hired trucks, the Caterpillar D6 and Caterpillar blade owned by the county, and the balance of the equipment was furnished by the state. There was a definite rental arrangement set up so that the equipment furnished by the state or county was charged against that unit's contribution to the project. There were 36 Ford, Chevrolet, Dodge and International trucks, furnished by the county or hired, and the P & H 400 dragline owned by the county which was used in the sand pit.

Personnel

The management of this project was similar to a contract. H. J. Zimmerman was appointed Superintendent for the State with authority to expend the appropriated funds for the work under the engineering supervision of Sam Norton, Resident Engineer.

Reinforced Concrete, Theory and Practice

A new and very practical book on the design of reinforced concrete structures has just made its appearance under the authorship of Clarence W. Dunham, Civil Engineer, Department of Engineering, The Port of New York Authority. Mr. Dunham has side-stepped the extreme refinements of design and calculation, realizing that assumed loads, their distribution, and the allowable unit stresses are often rather approximate and are based upon judgment and experience. The first half-dozen chapters amount to an elementary course in the design of reinforced concrete, while the remainder of the text is designed especially for practicing engineers. All of the methods used in illustrating problems are those which would be encountered in any large engineering office, thus making the book valuable for any practicing engineer who is called upon to design any concrete structure.

Special attention is given to retaining walls, foundations, rigid frames, arches, building frames and miscellaneous structures. The price of the book is $4.50, and copies may be secured direct from the McGraw-Hill Book Co., or through CONTRACTORS AND ENGINEERS MONTHLY.

Coffee Prices are Boosted By the Lack of Good Roads

The report comes from Cuba that one of the reasons of the present high price of coffee in that country is the inaccessibility of the areas of production and the difficulty and expense of transportation over the highways in marketing the crop. A tax has now been placed on coffee in Cuba to be used for the improvement and advancement of the industry and for the construction of roads in those coffee-producing areas where roads are either non-existent or amount to mere tracks.

The Secretary of Agriculture of Cuba has announced that the roads are being constructed for the welfare of the coffee industry as well as the farmers engaged therein, and that the contemplated roads will be constructed in those areas most in need of better transportation and in those districts where the coffee growers are too poor to provide the necessary finances or facilities. Road construction, according to the U. S. Bureau of Foreign & Domestic Commerce, will be undertaken in the three provinces of Oriente, Santa Clara and Pinar del Rio, but principally in Oriente in the districts of Altos Sangos, El Cobre, Jijuani and Yateras.

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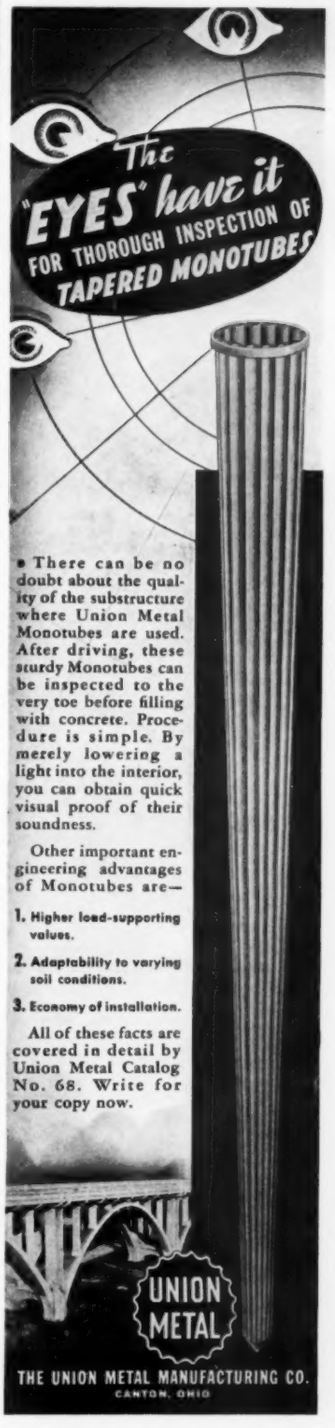

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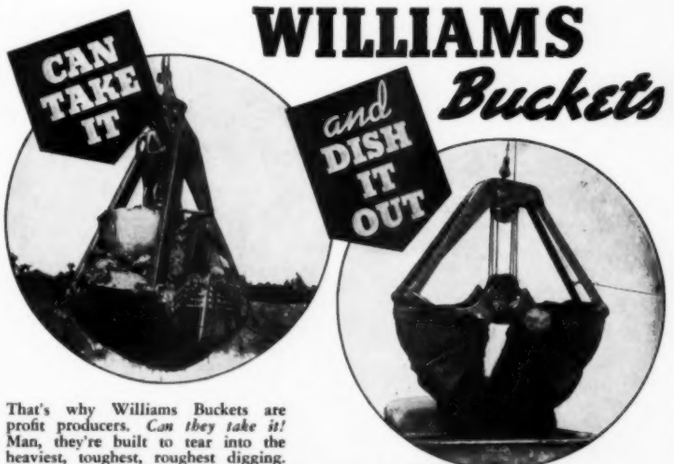

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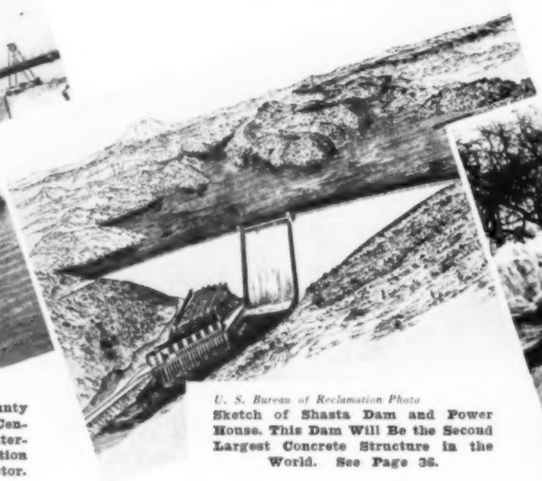

U. S. Bureau of Reclamation Photo

Sketch of Shasta Dam and Power House. This Dam Will Be the Second Largest Concrete Structure in the World. See Page 36.

Result of Differential Heaving on a Concrete Road, with More Heaving at the Crown Than the Sides, Causing Bad Cracks and Corner Breaks. See Page 2.

C. & E. M. Photos

Scenes on an Alabama State Highway Dept. and Baldwin County Joint Road Project Near Foley. Top, Loading Base Course Material, and Bottom, Wetting Down the Shoulders. See Page 1.

One of the New Pieces of Dirt-Moving Equipment in Use by Guy F. Atkinson Co. at Hansen Dam, California, Is the Dragveyor, Shown Above, Served by a Bucyrus-Erie Electric Crane with a 90-Foot Boom and an 8-Yard Sauerman Crescent Scraper Bucket. At Left, a Close-Up of the Bucket Pulling Up Earth Against the Lower End of the Belt Conveyor.

See Page 1.

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